TECHNICAL BULLETIN No. 90 JUNE, 1929

IMP. BUR.
- 3 JUL. 1929
ENTOM.
E&A

LIFE HISTORY OF THE CODLING MOTH IN NORTHERN GEORGIA

BY

E. R. VAN LEEUWEN
Associate Entomologist, Division of Deciduous Fruit Insects
Bureau of Entomology

UNITED STATES DEPARTMENT OF AGRICULTURE, WASHINGTON, D. C.

U. S. GOVERNMENT PRINTING OFFICE: 1929

TECHNICAL BULL. No. 90 JUNE, 1929

UNITED STATES DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

LIFE HISTORY OF THE CODLING MOTH IN NORTHERN GEORGIA

By E. R. VAN LEEUWEN [1]

Associate Entomologist, Division of Deciduous Fruit Insects, Bureau of Entomology

CONTENTS

	Page
Introduction	1
Location	2
Explanation of terms	3
Methods of procedure	4
Seasonal-history studies of 1920	5
Generations in a season	5
Wintering larvae	5
Pupae of the spring brood	6
Moths of the spring brood	7
The first generation	10
The second generation	16
The third generation	24
The fourth generation	30
Band-record experiments of 1920	30
Orchards in Cornelia	30
The Dunson orchard	33
The Smith orchard	36
House No. 2 orchard	37
House No. 1 orchard	40
Summary of band records	41
Seasonal-history studies of 1921	42
Source of wintering material	42
Pupae of the spring brood	44
Moths of the spring brood	46
The first generation	48
The second generation	57
The third generation	65
The fourth generation	70
Band-record experiments of 1921	72
The Cornelia orchard	73
Orchard at View	75
Natural enemies of the codling moth	77
Miscellaneous studies	78
Observations on copulation and oviposition of codling moths of the spring brood, 1920	78
Hourly emergence of moths of the spring brood, 1921	81
Time spent in emerging by moths of the spring brood, 1921	81
Hourly emergence of the first-brood codling moths, 1921	82
Oviposition by individual codling moths of the spring brood, 1921	83
Oviposition by individual codling moths of the first brood, 1921	83
Experiment with upper and lower bands	84
Hibernating habits of codling-moth larvae	85
Efficiency of bands in trapping larvae	86
Summary	86
Spring brood	90
First generation	90
Second generation	91
Third generation	92
Fourth generation	93
Spraying schedule	93

INTRODUCTION

During the years 1920 and 1921 the Bureau of Entomology of the United States Department of Agriculture maintained a field laboratory at Cornelia, Ga., for the purpose of conducting life-history studies of the codling moth, *Carpocapsa pomonella* L. This bulletin deals with the life history and habits of the codling moth as observed during these two years.

The codling moth has been studied to a greater or less degree in nearly every fruit-growing section of this country, but never as far

[1] The writer, who was in direct charge of the work covered by this report, was assisted during the season of 1921 by G. A. Crisp. The work was conducted under the direction of A. L. Quaintance, in charge of deciduous fruit insect investigations for the Bureau of Entomology, whose practical suggestions have been of great assistance.

south as the Cornelia district in the Southern States. The time of the appearance of the different stages of this insect varies, in accordance with the climatic conditions under which it lives. Hence a more complete knowledge of the seasonal habits of the codling moth was desired for the apple-growing district of northern Georgia. This bulletin should form a basis for constructive control measures for the use of orchardists in this district.

LOCATION

The apple-growing district of northern Georgia is located in Habersham County, in the region known as the Piedmont belt. The surface is broken by low mountains connected with the Blue Ridge Mountains. It is a region of faint relief eroded on highly complicated crystalline rocks. The surface soil is generally sandy, but in a considerable area the subsoil is a red clay derived largely from the decomposition of hornblende. The apple orchards are located on the southern slope of the mountains. Most of the bearing orchards are within 12 miles of Cornelia. A number of orchards are planted to the north of Cornelia, being very much scattered over partially level foothills and valleys. The general elevation of the orchard land varies from 1,537 to 2,000 feet above sea level. The climate is comparatively uniform, with moderate temperatures and high relative humidity. The average annual rainfall amounts to 49.3 inches. The rains are generally accompanied by high winds. The day temperatures during the summer season are high, while at night the temperatures are generally low.

Temperature, precipitation, and other climatological data, compiled from the records of the United States Weather Bureau station at Cornelia, Ga., are given in Tables 1 and 2.

TABLE 1.—*Climatological data for Cornelia, Ga., 1920*

Month	Temperature						Precipitation			Number of days—				Prevailing direction of wind
	Mean	Extremes: Highest	Day of month	Extremes: Lowest	Day of month	Greatest daily range	Total	Greatest in 24 hours	Snowfall (unmelted)	With precipitation (0.01 inch or more)	Clear	Partly cloudy	Cloudy	
	°F.	°F.		°F.		°F.	*Inches*	*Inches*	*Inches*					
January	41.4	65	22	6	5	33	6.98	1.73	T	13	15	2	14	E.
February	40.0	65	23	9	16	32	3.98	1.46	T	8	11	10	8	W.
March	48.2	75	28	11	8	32	8.95	1.37	0.0	10	16	3	12	W.
April	57.4	84	17	26	6	35	9.84	2.41	T	15	11	6	13	E.
May	66.2	87	23	47	9	34	3.78	1.05	.0	8	14	8	9	E.
June	74.7	94	12	58	21	29	4.60	1.76	.0	8	16	9	5	W.
July	75.9	91	24	60	9	28	4.59	1.21	.0	13	7	18	6	W.
August	73.6	87	1	60	5	20	9.80	2.29	.0	17	1	11	19	E.
September	71.2	87	12	47	30	25	2.33	0.75	.0	7	19	6	5	E.
October	61.1	81	10	33	30	31	0.94	0.85	.0	3	28	0	3	W.
November	48.6	75	8	22	14	33	4.49	1.20	.0	8	16	7	7	W.
December	41.0	62	3	18	25	30	6.83	1.30	T	11	14	4	13	W.

TABLE 2.—*Daily temperatures at Cornelia, Ga., March to November, 1920*

Day of month	March		April		May		June		July		August		September		October		November	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.	°F.
1	66	35	63	39	71	44	84	61	93	70	94	68	92	70	69	53	54	48
2	72	40	66	39	62	43	82	61	92	71	91	71	92	68	65	53	61	41
3	68	52	72	43	55	43	83	65	91	68	89	71	92	66	77	60	61	36
4	60	30	71	46	62	44	86	62	92	69	86	68	92	70	65	45	65	38
5	66	34	73	47	63	48	77	64	93	71	77	66	91	70	64	34	72	45
6	71	42	73	51	69	46	79	62	86	72	82	65	91	69	69	43	66	45
7	73	53	79	56	73	45	77	61	84	70	89	67	93	66	71	45	72	48
8	74	56	78	59	78	50	90	60	91	70	86	67	86	67	65	42	67	52
9	71	60	75	59	82	48	88	64	92	68	80	62	84	67	67	36	63	50
10	63	40	62	41	72	58	86	66	93	66	83	68	87	68	75	46	60	40
11	63	43	62	31	76	54	89	65	94	69	85	66	88	64	78	51	58	32
12	65	52	66	33	74	52	87	69	88	65	86	67	88	65	68	40	53	34
13	76	48	71	43	74	58	93	68	83	65	85	69	85	67	59	38	49	27
14	75	51	65	54	80	56	98	69	83	67	87	67	87	65	61	36	53	40
15	81	53	77	58	75	57	89	71	86	69	80	63	87	68	67	48	70	46
16	77	56	75	58	73	57	91	66	84	66	69	61	87	65	73	48	61	54
17	79	53	65	38	72	52	93	68	85	68	86	67	88	66	72	49	66	53
18	83	55	52	32	76	51	93	68	84	68	87	66	88	68	76	51	70	58
19	68	56	67	37	76	54	89	65	85	71	87	68	87	68	76	52	66	58
20	75	57	72	45	68	60	72	65	78	68	90	67	88	68	67	47	64	46
21	82	56	72	51	75	60	79	62	82	67	94	69	85	70	64	38	60	42
22	82	59	63	54	80	63	86	66	80	62	77	66	84	60	69	39	65	34
23	68	44	74	50	85	60	97	68	80	64	80	66	86	65	75	45	69	39
24	50	43	80	50	89	65	90	70	84	66	77	63	85	62	74	48	71	45
25	71	47	84	56	85	58	94	68	85	66	78	64	87	62	75	50	64	56
26	77	55	83	61	89	65	85	65	86	66	76	62	83	62	67	54	58	44
27	81	55	75	62	89	63	93	69	85	65	75	59	73	63	63	49	57	50
28	78	52	77	52	89	63	92	70	87	68	76	60	82	64	69	52	58	40
29	56	39	69	51	89	63	93	70	88	68	82	65	83	64	70	53	65	31
30	51	40	65	47	86	62	94	68	90	70	88	65	78	65	68	57	64	38
31	50	42	----	----	81	65	----	----	93	68	91	68	----	----	62	49	----	----
Mean	70.1	48.3	70.9	48.1	76.4	55.1	87.6	65.9	87.0	67.8	83.6	65.8	86.6	66.1	69.0	46.8	62.7	43.7

EXPLANATION OF TERMS

The term "brood" is applied to any stage of the codling moth in any generation. The four terms used will be "brood of eggs," "brood of larvae," "brood of pupae," and "brood of moths." However, the larvae which live over the winter to form the spring brood of pupae and moths are known as "wintering" larvae, instead of as "spring-brood" larvae. Larvae that transform into pupae the same season in which they are hatched are spoken of as "transforming" larvae.

A "generation" begins with the egg stage and includes all consecutive stages, ending with the moth stage. The first generation includes the first eggs laid in the spring, the first brood of larvae, pupae, and moths.

A distinction is made between a life cycle and a complete life cycle. The life cycle includes the time from the deposition of the eggs to the emergence of the moth during the same season in which the eggs were deposited. It includes the length of the incubation period of the eggs, the time spent in the larval stage, and the time spent in the pupal stage, but not the length of life of the resulting moths or adults. The complete life cycle extends from the deposition of the eggs to the deposition of the eggs of the following brood.

Wintering larvae are nontransforming larvae of the preceding year which pass the winter in the larval stage. They may include larvae of the first, second, third, and fourth broods of the previous season.

METHODS OF PROCEDURE

The general plan for conducting life-history studies of the codling moth, as outlined by the Bureau of Entomology, was used in obtaining the data herein recorded. The writer assisted with most of the life-history studies of the codling moth carried on in Michigan, Maine, New Mexico, and Colorado, as reported in bulletins [2] of the United States Department of Agriculture. With the exception of a few improvements in the system of obtaining the records, the work as carried out was similar to that of the investigations already published. Most of the work was conducted in an insectary erected under a number of large shade trees on the grounds at the laboratory. It was of open-type construction, well screened, 32 feet long, 12 feet wide, with a flat sloping roof 11 feet from the ground at the lowest elevation. The eaves were wide, but, owing to the great amount of wind which accompanied every rainstorm, it was impossible at times to keep the rearing cages from becoming wet. The temperatures in the insectary closely paralleled those in the orchard, as was determined by the use of thermometers and a hygrothermograph. Checks were obtained on the weather conditions by referring to a daily report of the field station of the Weather Bureau, located 1 mile from the insectary. The insectary was well shaded, the direct rays of the sun never being permitted to reach the glass rearing cages.

The rearing cages used in these studies consisted of glass battery jars of different sizes. Most of the larger jars were 6 by 8 inches and were covered with cheesecloth when necessary to keep the insects from escaping. To hold the cloth in place two No. 32 rubber bands were used. The records for each cage were kept on a separate sheet of notebook paper attached to the outside of the cage by the use of rubber bands. The reader should bear in mind that each table is a unit in itself. Successive tables are not continuations of the life history of all of the individuals given in the preceding tables.

In obtaining pupation records, the larvae were permitted to spin their cocoons in pupation racks, which were patterned after those employed by A. G. Hammar in his work with the codling moth. Each pupation rack was made of a piece of soft wood, 8 inches long, 1¾ inches wide, and one-fourth inch thick, having two rows of 18 grooves or cells each, all cells being a little larger than a full-grown larva. A piece of heavy celluloid, cut to the proper size, through which the insect could be observed without being disturbed, was used to cover the grooves. Over the celluloid was placed a thin strip of wood to darken the cells, this being held in place by the use of wire clips. With the aid of this device the cocooning and pupation periods and the time of emergence of the moths were recorded.

In the oviposition cages the larger jars were used. An inch and a half of light sand was placed in each cage. This sand was kept at the proper moisture and was covered with a small screen of one-

[2] Life-History Studies of the Codling Moth in Michigan, Bur. Ent. Bul. 115, part 1, 1912; Life History of the Codling Moth in Maine, Dept. Bul. 252, 1915; Life History of the Codling Moth in the Pecos Valley, New Mexico, Dept. Bul. 429, 1917; Life History of the Codling Moth in the Grand Valley of Colorado, Dept. Bul. 932, 1921.

sixteenth inch mesh to prevent the moths from ovipositing on the sand. A fresh twig of pear leaves was placed daily in the jars, as was also a small piece of sponge, well saturated with a solution of sugar and honey. The small screen used to cover the sand also prevented the solution of sugar and honey from being absorbed by the sand. Moths issuing on different dates were placed in separate cages for records of oviposition and length of life.

The eggs deposited on the leaves were counted daily and placed in a separate jar, containing a layer of moistened sand, for incubation records. The leaves containing eggs were kept from curling by being placed between pieces of screen for a few days. When large numbers of eggs were deposited, only 100 were used to obtain the time of appearance of the red ring and the black spot and the length of the incubation period. The feeding period of the larvae was obtained by placing newly hatched larvae on apples growing on the trees, these apples being then covered with paper bags, and by placing apples in the cages where newly hatched larvae could immediately start feeding. The infested apples were placed in a wire basket within a battery jar, in which was also placed a cocooning rack. The cocooning rack was examined daily for full-grown larvae, and thus the feeding period was obtained.

SEASONAL-HISTORY STUDIES OF 1920

The temperature and atmospheric conditions have a considerable influence upon the appearance of the different stages of the insect. The time of the emergence of the moth, the length of the incubation period, the time of the hatching of the egg, and the length of the pupal stage fluctuate more or less in accordance with climatic conditions. There is also a considerable individual variation in the length of time the insect spends in its different stages. Individuals under exactly the same conditions will vary, and reliable conclusions can not be drawn from a small number of observations. The tables in this bulletin deal with many individuals, and the averages are determined from the total number.

GENERATIONS IN A SEASON

In northern Georgia the codling moth produces in one season one full generation and four partial generations. Nearly all first-brood larvae transform to pupae, eventually giving rise to the second brood of larvae. The number transforming decreases with each brood, and all larvae of the fifth brood pass the winter as larvae. The number wintering from each brood is given in the discussion of each generation.

WINTERING LARVAE

Early in March, 1920, large numbers of larvae were collected in the field from beneath the rough bark scales on the apple trees and also from boxes and bins in packing houses. These overwintering larvae were allowed to spin up in the regular cocooning racks for pupation records. The Yonah Fruit Co. at Cornelia deserves special mention for the courtesies shown the writer in permitting him to tear apart the apple bins within the packing houses and storage cellars in search of larvae and also for permitting the writer to use the large orchard on many occasions.

PUPAE OF THE SPRING BROOD

Time of pupation.—Over 700 larvae were collected before pupation started, but the mortality was high and only 481 pupated. Daily observations were made and as each larva pupated it was given a number. Table 3 and Figure 1 show the results of the daily observations of the time of pupation. It will be noted that the earliest pupation occurred on March 24 and that the larvae did not pupate in large numbers until three weeks later. Cold, rainy weather retarded the pupation in late March. The pupation period extended over two months, the last pupation taking place on May 23. Daily observations were made in the orchard to determine the percentages

FIG. 1.—Time of pupation of the spring brood of the codling moth, Cornelia, Ga., 1920

of pupae and larvae, these observations being used as a check against the insectary material.

TABLE 3.—*Time of pupation of 481 wintering larvae of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
Mar. 24	1	Apr. 10	6	Apr. 22	33	May 3	3
Mar. 25	1	Apr. 11	21	Apr. 23	27	May 5	1
Mar. 26	1	Apr. 12	12	Apr. 24	17	May 7	2
Mar. 28	2	Apr. 14	6	Apr. 25	6	May 8	1
Apr. 1	2	Apr. 15	14	Apr. 26	10	May 9	1
Apr. 2	5	Apr. 16	28	Apr. 27	8	May 10	1
Apr. 3	1	Apr. 17	64	Apr. 28	18	May 11	2
Apr. 4	3	Apr. 18	25	Apr. 29	11	May 21	1
Apr. 7	1	Apr. 19	53	Apr. 30	10	May 23	1
Apr. 8	11	Apr. 20	27	May 1	10		
Apr. 9	5	Apr. 21	25	May 2	4	Total	481

Length of the pupal stage.—The results of observations on the time of pupation of 396 individuals are given in Table 4. The average length of the pupal stage was 23 days, the maximum 38, and the minimum 17. The first larvae spent on an average 33 days in the pupal stage, while those pupating two weeks later spent about 22 days in the pupal stage.

TABLE 4.—*Length of the pupal stage of 396 pupae of the spring brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days																			
		17	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	38
Mar. 24	1																				1
Mar. 25	1																		1		
Mar. 26	1																			1	
Mar. 28	3																2	1			
Apr. 1	1														1						
Apr. 2	5											1	1	2		1					
Apr. 3	1														1						
Apr. 4	3													3							
Apr. 7	1										1										
Apr. 8	11						1	1		5	4										
Apr. 9	5								3	2											
Apr. 10	6							3	3												
Apr. 11	16						1	10	2	2			1								
Apr. 12	9						3	2	2	2											
Apr. 14	5				1	2		2													
Apr. 15	10				1	3	3	2	1												
Apr. 16	23			1	6	10	4	1				1									
Apr. 17	57			1	12	28	13	3													
Apr. 18	21			3	5	8	5														
Apr. 19	50			3	23	20	3	1													
Apr. 20	22			1	14	7															
Apr. 21	21			4	11	4		1			1										
Apr. 22	26			3	12	4	3	3			1										
Apr. 23	18			1	1	1	5	3	2	5											
Apr. 24	12								6	6											
Apr. 25	4								4												
Apr. 26	8						1	5	1	1											
Apr. 27	8						1	7													
Apr. 28	13				2	4	5	1	1												
Apr. 29	6			1	1	2	2														
Apr. 30	7					3	3	1													
May 1	7						6			1											
May 2	3					2		1													
May 3	2						2														
May 5	1					1															
May 7	2					2															
May 8	1						1														
May 9	1				1																
May 10	1				1																
May 11	2	1			1																
May 21	1		1																		
Total	396	1	1	18	92	101	62	47	25	24	7	2	2	5	2	1	2	1	1	1	1

MOTHS OF THE SPRING BROOD

Time of emergence.—The emergence of moths of the spring brood began as early as April 20 and continued more or less regularly until the first part of June. (Table 5 and fig. 2.) The maximum emergence took place May 10. A total of 459 moths of the spring brood emerged.

TABLE 5.—*Time of emergence of 459 codling moths of the spring brood, Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
Apr. 20	1	May 6	11	May 16	10	May 27	3
Apr. 21	1	May 7	18	May 17	6	May 28	2
Apr. 23	1	May 8	35	May 18	5	May 29	2
Apr. 27	1	May 9	46	May 19	18	May 30	1
Apr. 29	2	May 10	51	May 20	22	May 31	2
Apr. 30	5	May 11	50	May 21	14	June 1	1
May 1	8	May 12	27	May 22	8	June 9	1
May 2	5	May 13	20	May 23	6		
May 4	22	May 14	8	May 24	10	Total	459
May 5	27	May 15	5	May 26	4		

Oviposition by moths of the spring brood.—Moths emerging from April 20 to May 2, inclusive, were placed in one cage for the purpose of obtaining the first eggs of the season. Hence 18 male and 10 female moths were confined in cage No. 1, as shown by Table 6. The majority of the 270 moths had commenced to oviposit three days

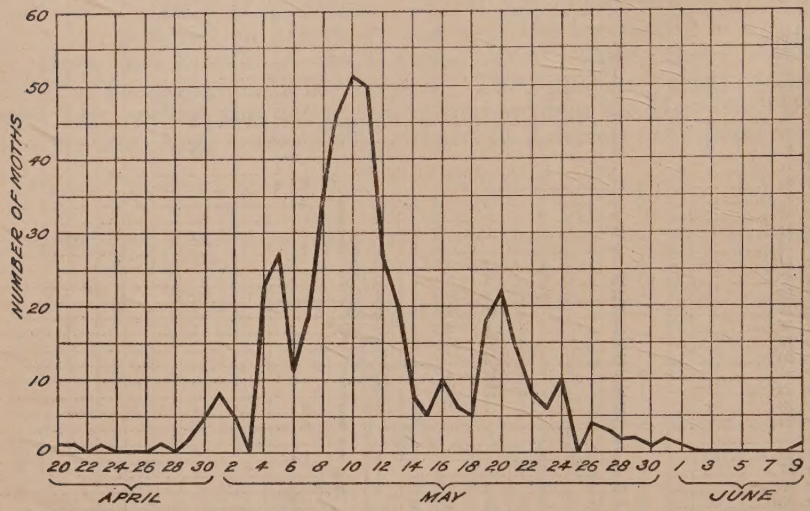

FIG. 2.—Time of emergence of codling moths of the spring brood, Cornelia, Ga., 1920

after the date of emergence, and most of the eggs were laid within a week after emergence. The average period of oviposition was 17.92 days.

TABLE 6.—*Oviposition by 270 codling moths of the spring brood in rearing cages, Cornelia, Ga., 1920*

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
1	1	1		Apr. 20	May 6		403			
	1	1		Apr. 21						
	1		1	Apr. 23						
	2	2		Apr. 27						
	2	1	1	Apr. 29						
	9	6	3	Apr. 30						
	8	5	3	May 1						
	4	2	2	May 2						
2	31	22	9	May 5	May 9	June 2	954	4	25	28
3	20	14	6	May 6	May 11	May 26	238	5	16	20
4	28	12	16	May 7	May 10	May 30	573	3	21	23
5	37	19	18	May 8	May 11	June 4	993	3	25	27
6	27	15	12	May 9	May 13	May 29	530	4	17	20
7	28	13	15	May 9	May 12	May 28	699	3	17	19
8	22	12	10	May 10	May 13	May 28	501	3	16	18
9	15	10	5	May 10	May 14	June 5	120	4	23	26
10	28	12	16	May 10	May 13	June 9	707	3	28	30
11	31	14	17	May 11	May 14	June 3	496	3	21	23
12	33	13	20	May 11	May 17	June 3	1,188	6	18	23
13	16	1	15	May 12	May 15	May 30	399	3	16	18
14	24	7	17	May 12	May 15	June 5	410	3	22	24
15	26	11	15	May 13	May 15	June 9	878	2	26	27

TABLE 6.—*Oviposition by 270 codling moths of the spring brood in rearing cages, Cornelia, Ga., 1920*—Continued

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
16	5	3	2	May 14	May 28	June 5	41	14	9	22
17	4	2	2	May 15	May 24	May 30	10	9	7	15
18	14	3	11	May 16	May 21	June 6	105	5	17	21
19	3	1	2	May 17	May 27	May 27	3	10	1	10
20	3	3		May 18						
21	16	4	12	May 19	May 22	June 8	142	3	18	20
22	20	5	15	May 20	May 22	May 30	28	2	9	10
23	14	6	8	May 21	May 23	June 8	182	2	17	18
24	8	3	5	May 22	May 26	May 31	78	4	6	9
25	9	5	4	May 23	May 26	June 1	80	3	7	9
26	3	3		May 24						
27	3	1	2	May 26	May 29	June 10	137	3	13	15
28	4	1	3	May 27	June 2	June 12	69	6	11	16
29	2	1	1	May 28	June 13	June 14	2	16	2	17
30	1	1		May 29						
31	2	1	1	May 31						
32	1		1	June 1	June 14	June 14	2	13	1	13
33	1	1		June 9						
Total	507	237	270				9,968			

Number of eggs per female moth.—Spring-brood moths deposited fewer eggs than those of later broods, doubtless because a considerable part of their stored-up energy was used in wintering. The average number of eggs per female moth was 36.92, 270 females depositing a total of 9,968 eggs.

Length of life of moths.—A summary of observations on the life of 483 moths is given in Table 7. The average length of life of 218 male moths was 16.05 days; of 265 female moths 16.80 days. The maximum length of life of the male moths was 41 days, of the female moths 33 days.

TABLE 7.—*Length of life of 218 male and 265 female codling moths of the spring brood in captivity, Cornelia, Ga., 1920*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*			*Days*		
2	1	2	15	12	21	28	2	3
3	2	3	16	12	17	29	3	4
4	2	2	17	16	22	30	1	1
5	1	1	18	11	19	31	0	1
6	3	0	19	9	9	32	2	1
7	2	3	20	6	16	33	1	2
8	8	7	21	5	17	35	1	0
9	5	4	22	4	10	37	1	0
10	10	13	23	5	7	41	1	0
11	13	10	24	4	7			
12	11	10	25	8	5	Total	218	265
13	29	18	26	4	2			
14	20	21	27	3	7			

THE FIRST GENERATION

EGGS OF THE FIRST BROOD

Time of deposition.—The first eggs of this brood were deposited May 6, and deposition continued for a period of five weeks. The maximum egg laying for this brood occurred on May 19. (Fig. 3.)

Length of incubation.—Table 8 gives the records of incubation of the first-brood eggs. The average incubation period of 11,830 eggs was

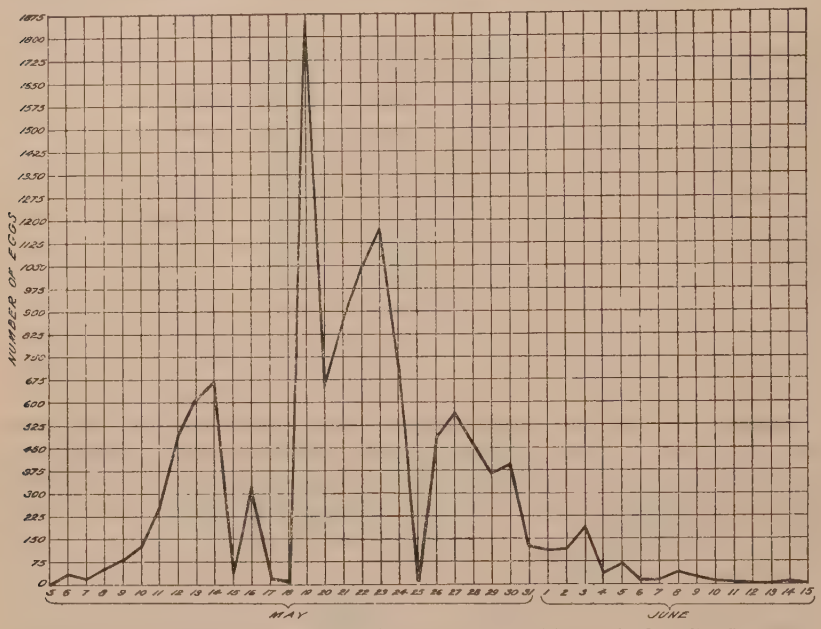

FIG. 3.—Time of deposition of eggs of the first brood of the codling moth, Cornelia, Ga., 1920

8.22 days. The shortest period of incubation was 5 days; the longest 12. During low temperatures early in the spring the incubation period was longer than it was later in the spring when the temperatures were higher. The red ring and black spot appeared very regularly during the incubation period. The average length of time from the date of deposition to the appearance of the red ring was 3.53 days, maximum 5, minimum 3. The average length of time from oviposition to the appearance of the black spot was 6.7 days, maximum 10, minimum 4.

TABLE 8.—*Time of deposition, length of incubation, and time of hatching of 12,069 eggs of the first brood of the codling moth, Cornelia, Ga., 1920*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
1	35	May 6	May 9	May 14	May 16	24	3	8	10	
2		do	do	do	May 17	11	3	8	11	
3	22	May 7	May 10	May 15	do	5	3	8	10	
4		do	do	do	May 18	14	3	8	11	
5		do	do	do	May 19	3	3	8	12	
6	54	May 8	May 12	May 16	May 18	4	4	8	10	
7		do	do	do	May 19	36	4	8	11	
8		do	do	do	May 20	14	4	8	12	
9	83	May 9	do	May 19	do	66	3	10	11	
10		do	do	do	May 21	17	3	10	12	
11	126	May 10	May 13	May 20	do	37	3	10	11	
12		do	do	do	May 22	89	3	10	12	
13	256	May 11	May 14	do	May 21	31	3	9	10	
14		do	do	do	May 22	225	3	9	11	
15	480	May 12	May 15	May 22	May 23	461	3	10	11	
16		do	do	do	May 24	19	3	10	12	
17	605	May 13	May 16	May 23	do	605	3	10	11	
18	663	May 14	May 19	do	do	630	5	9	10	
19		do	do	do	May 25	33	5	9	11	
20	32	May 15	do	May 24	do	27	4	9	10	
21		do	do	do	May 26	5	4	9	11	
22	323	May 16	May 20	do	do	307	4	8	10	
23		do	do	do	May 27	16	4	8	11	
24	20	May 17	May 21	do	May 26	20	4	7	9	
25	8	May 18	May 22	May 25	May 27	8	4	7	9	
26	1,850	May 19	May 23	May 26	do	1,702	4	7	8	
27		do	do	do	May 28	148	4	7	9	
28	656	May 20	do	do	May 27	643	3	6	7	
29		do	do	do	May 28	13	3	6	8	
30	880	May 21	May 24	May 27	do	106	3	6	7	
31		do	do	do	May 29	774	3	6	8	
32	1,048	May 22	May 25	May 28	do	126	3	6	7	
33		do	do	so	May 30	922	3	6	8	
34	1,171	May 23	May 27	May 29	do	176	4	6	7	
35		do	do	do	May 31	960	4	6	8	35
36	717	May 24	May 28	May 30	do	717	4	6	7	
37	9	May 25	May 29	May 31	June 1	9	4	6	7	
38	485	May 26	May 30	do	June 2	485	4	5	7	
39	562	May 27	do	June 1	do	101	3	5	6	
40		do	do	do	June 3	444	3	5	7	17
41	452	May 28	May 31	June 2	June 4	407	3	5	7	
42		do	do	do	June 5	41	3	5	8	4
43	369	May 29	June 1	June 3	do	221	3	5	7	
44		do	do	do	June 6	48	3	5	8	100
45	397	May 30	June 2	June 4	do	349	3	5	7	
46		do	do	do	June 7	8	3	5	8	40
47	128	May 31	June 3	June 5	do	119	3	5	7	
48		do	do	do	June 8	5	3	5	8	4
49	112	June 1	June 4	June 7	do	66	3	6	7	
50		do	do	do	June 9	36	3	6	8	10
51	115	June 2	June 5	June 8	do	95	3	6	7	
52		do	do	do	June 10	17	3	6	8	3
53	187	June 3	June 7	June 9	do	172	4	6	7	
54		do	do	do	June 11	6	4	6	8	9
55	38	June 4	June 8	June 10	do	37	4	6	7	
56		do	do	do	June 12	1	4	6	8	
57	64	June 5	June 9	do	June 11	44	4	5	6	
58		do	do	do	June 12	12	4	5	7	8
59	15	June 6	June 10	June 11	do	10	4	5	6	
60		do	do	do	June 13	5	4	5	7	
61	15	June 7	June 11	June 12	do	12	4	5	6	
62		do	do	do	June 14	3	4	5	7	
63	44	June 8	do	do	June 13	30	3	4	5	
64		do	do	do	June 14	14	3	4	6	
65	27	June 9	June 12	June 13	do	20	3	4	5	
66		do	do	do	June 15	7	3	4	6	
67	11	June 10	June 13	June 14	do	11	3	4	5	
68	3	June 11								3
69	3	June 12			June 17	1			5	2
70	1	June 13								1
71	3	June 14								3
Total	12,069					11,830				
Average							3.53	6.70	8.22	239

LARVAE OF THE FIRST BROOD

Time of hatching.—Table 8 shows that the earliest eggs hatched on May 16 and that eggs of this brood continued to hatch for a period of one month.

Length of the feeding period.—The length of the feeding period for larvae of the first brood was determined from observations of a total of 1,984 individuals. The length of the feeding period ranged from 11 to 31 days; the average was 17.55 days. Table 9 is for both the transforming and wintering larvae.

TABLE 9.—*Length of feeding period of 1,984 larvae of the first brood of the codling moth, stock-jar method, Cornelia, Ga., 1920*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																				
		11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
May 19	33										5	11	8	3		4	1			1		
May 20	9										2	2	1	4								
May 21	21									3	4	8	1	3	2							
May 22	73							2	5	19	21	11	2	6	4			1	1		1	
May 23	95							10	14	20	23	11	7	2	5	3						
May 24	114						13	6	37	20	9	19	8		2							
May 25	21							1		4	6	2	2	3			2		1			
May 26	48							6	13	11	8	8	2									
May 27	247					8	42	65	63	36	16	12	5									
May 28	164					3	19	29	46	27	19	9	9	1	2							
May 29	106					2	13	28	24	16	13	4	3	3								
May 30	151				14	49	40	26	10	6	2	1	1	2								
May 31	162				14	50	61	12	13	1	1	2	3	1	1		1		1			1
June 1	117				16	36	19	24	4	3	5	4		1	1	2			2			
June 2	124			1	21	39	33	6	8	7	1	4	3				1					
June 3	113			9	34	23	19	10	6	6	1		2				3					
June 4	72			5	21	14	13	8	5	4		2										
June 5	50		1	4	8	3	10	7	5	3	3		1	2	1		1			1		
June 6	60			3	3	15	5	10	9	7	5		1	2								
June 7	38			1	9	8	5	2	7	3	3											
June 8	19	2			1	2	7	3	3	1												
June 9	14			1		5	3	1	3						1							
June 10	51			2	4	10	9	9	4	10	2			1								
June 11	31				2	5	7	10	4	1	1				1							
June 12	12					4	4	1	1	1					1							
June 13	18					1	1	6	3	6	1											
June 14	12							2	5	2	3											
June 15	7						1	3	1	2												
June 17	2	1					1															
Total	1,984	3	1	26	147	277	325	287	293	219	154	110	59	34	21	9	9	1	5	2	1	1

Time of leaving the fruit.—The first larvae left the fruit in the insectary on June 8 when four larvae appeared. The first larvae from the band records were collected on the same day.

Length of the cocooning period.—The cocooning period herein recorded was determined as being the period from the time the larvae left the fruit until the time of pupation. The larvae ceased to be active from 2 to 3 days before pupation. The cocooning period varied from 1 to 16 days, with an average of 5.08 days for the 1,569 individuals. (Table 10.)

Percentage of transforming and wintering larvae.—Only 50 of the 1,984 larvae failed to transform; that is, 2.52 per cent of the larvae wintered, and 97.48 per cent transformed.

TABLE 10.—*Length of cocooning period of 1,569 transforming larvae of the first brood of the codling moth, Cornelia, Ga., 1920*

Larvae left fruit	Number of individuals	Number of individuals having cocooning periods [1] of specified number of days																Average	Maximum	Minimum
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16			
																		Days	*Days*	*Days*
June 12	101		7	63	17	9	2		1		1					1		3.57	15	2
June 13	148		10	70	55	4	2	6	1									3.59	8	2
June 14	207		4	101	51	31	5	4	7	1	2					1		4.00	15	2
June 15	220		7	32	94	33	22	18	5	4	3	2						4.71	11	2
June 16	203		2	3	41	73	41	19	14	4	2	3				1		5.60	15	2
June 17	150			1	5	54	41	26	12	2	3	3		1	1	1		6.26	15	3
June 18	137				3	27	64	25	5	6	3	3			1			6.40	14	4
June 19	59				3	11	28	7	4	2		1	1	1			1	6.54	16	4
June 20	41				1	17	12	4	3	1		2		1				6.27	13	4
June 21	58				2	23	23	5	4			1						5.84	11	4
June 22	38		1		10	12	9	4	1		1							5.31	10	2
June 23	28			3	7	8	5	2	1		1		1					5.39	12	3
June 24	28		1	4	7	8	6	1									1	5.04	16	2
June 25	34				8	15	6		3	2								5.44	9	4
June 26	22			1	10	6	1	1	2						1			5.27	14	3
June 27	18			1	7	7	2		1									4.77	8	3
June 28	23			2	10	4	5			1			1					5.08	12	3
June 29	13	1		3	2	3	1		2					1				5.23	13	1
June 30	8			3	2	2	1											4.12	6	3
July 1	8			1	3	1	1	1					1					5.62	12	3
July 2	13			3	2	5		3										4.85	7	3
July 3	7			1	2	1	1	1								1		6.28	15	3
July 4	3					1		1		1								7.00	9	5
July 5	1									1								9.00	9	9
July 6	1				1													4.00	4	4
Total or average	1,569	1	32	292	343	355	278	128	66	25	16	15	4	4	3	5	2	5.08		

[1] Time from leaving the fruit to the time of pupation.

PUPAE OF THE FIRST BROOD

Time of pupation.—The earliest pupation of the first brood occurred June 10 and the last July 18. Pupations are thus shown to cover a period of 39 days. A total of 1,737 individuals were observed. (Table 11.)

TABLE 11.—*Time of pupation of 1,737 transforming larvae of the first brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
June 10	3	June 21	105	July 2	26	July 13	2
June 11	6	June 22	125	July 3	18	July 14	1
June 12	19	June 23	97	July 4	16	July 15	0
June 13	38	June 24	116	July 5	12	July 16	0
June 14	92	June 25	89	July 6	5	July 17	0
June 15	94	June 26	69	July 7	12	July 18	1
June 16	96	June 27	61	July 8	2		
June 17	169	June 28	44	July 9	5	Total	1,737
June 18	89	June 29	37	July 10	5		
June 19	128	June 30	37	July 11	1		
June 20	87	July 1	29	July 12	1		

Length of the pupal stage.—The pupal period of 1,546 pupae varied from 6 to 20 days, with an average of 12.07 days. (Table 12.)

TABLE 12.—*Length of the pupal stage of 1,546 pupae of the first brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days													
		6	7	8	9	10	11	12	13	14	15	16	17	19	20
June 10	3				1	2									
June 11	5					1	1	1			1	1			
June 12	17				2	2	7	6							
June 13	37					7	6	13	10		1				
June 14	91					3	9	26	29	24					
June 15	90					1	2	12	59	15					1
June 16	92							13	58	16	3			1	1
June 17	147				1	4	18	57	60	3	1	1	2		
June 18	80							14	43	23					
June 19	111						1	18	73	19					
June 20	80						7	28	38	5	2				
June 21	86				1	1	16	53	13	2					
June 22	110					4	30	50	25	1					
June 23	83				1	7	22	47	5	1					
June 24	96				2	10	49	28	6	1					
June 25	79				3	11	41	24							
June 26	57				3	11	34	6	1	1					1
June 27	56			1	1	18	21	14					1		
June 28	35				1	7	19	8							
June 29	27	1			1	8	13	2	2						
June 30	38				1	7	8	19	3						
July 1	26			4			8	10	4						
July 2	22		1		2	1	8	8	2						
July 3	17	1					4	8	4						
July 4	14				1		3	8	2						
July 5	11					1	4		6						
July 6	5						1	2	2						
July 7	10						2	3	4	1					
July 8	1			1											
July 9	10							1	8	1					
July 10	5						1	3	1						
July 11	1								1						
July 12	2							1	1						
July 13	1						1								
July 18	1								1						
Total	1,546	2	1	6	21	106	336	483	461	113	8	2	3	1	3

MOTHS OF THE FIRST BROOD

Time of emergence.—The first moth of this brood emerged June 19, the last emerged July 31. (Table 13.) The period of emergence extended over 43 days. The first emergence of a moth from the band-record material occurred June 21, which was close to the time the moths issued from the insectary material.

TABLE 13.—*Time of emergence of 1,718 codling moths of the first brood, from material reared at the insectary, Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 19	1	July 1	152	July 13	22	July 25	4
June 20	2	July 2	161	July 14	18	July 26	1
June 21	3	July 3	169	July 15	17	July 27	1
June 22	5	July 4	118	July 16	21	July 28	0
June 23	14	July 5	173	July 17	4	July 29	2
June 24	15	July 6	97	July 18	14	July 30	1
June 25	24	July 7	98	July 19	6	July 31	1
June 26	42	July 8	44	July 20	5		
June 27	42	July 9	57	July 21	3	Total	1,718
June 28	98	July 10	33	July 22	6		
June 29	91	July 11	15	July 23	3		
June 30	101	July 12	32	July 24	2		

Time of oviposition.—As shown by Table 14, the first eggs were deposited June 23 and the last August 11. From the field material the writer is led to believe that the maximum egg-laying occurred about July 12. Individual moths laid over a period of 10 days on the average, and commenced to oviposit 2 days after emergence.

TABLE 14.—*Oviposition by 600 codling moths of the first brood in rearing cages, Cornelia, Ga., 1920*

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
1	1	1		June 19	June 23		645			
	2	1	1	June 20						
	10	7	3	June 21						
	9	5	4	June 22						
2	11	6	5	June 23	June 25	July 4	294	2	10	11
3	21	15	6	June 24	June 26	July 2	274	2	7	8
4	25	9	16	June 25	June 27	July 5	895	2	9	10
5	35	18	17	June 26	June 28	do	1,010	2	8	9
6	32	13	19	June 27	do	July 7	1,483	1	10	10
7	28	18	10	June 28	June 30	July 6	525	2	7	8
8	16	7	9	June 29	July 1	July 8	381	2	8	9
9	23	10	13	June 30	do	July 10	502	1	10	10
10	23	10	13	July 1	July 2	July 12	706	1	11	11
11	27	14	13	do	do	July 14	1,118	1	13	13
12	30	11	19	July 2	July 3	do	1,286	1	12	12
13	30	12	18	do	July 4	July 15	575	2	12	13
14	28	13	15	July 3	do	July 14	959	1	11	11
15	26	12	14	do	July 5	July 12	714	2	8	9
16	31	17	14	July 4	do	July 14	1,001	1	10	10
17	30	17	13	do	July 6	July 15	349	2	10	11
18	29	11	18	July 5	July 7	July 16	978	2	10	11
19	23	12	11	do	do	July 18	868	2	12	13
20	27	13	14	July 6	July 8	do	1,279	2	11	12
21	28	17	11	do	do	do	1,302	2	11	12
22	25	11	14	July 7	July 9	July 17	1,639	2	9	10
23	25	12	13	do	do	July 16	517	2	8	9
24	25	9	16	July 8	July 10	July 20	484	2	11	12
25	21	10	11	July 9	July 11	July 19	833	2	9	10
26	31	15	16	do	do	July 23	1,406	2	13	14
27	27	13	14	July 10	July 12	July 22	1,803	2	11	12
28	26	14	12	July 11	July 13	July 21	1,346	2	9	10
29	32	17	15	July 12	July 14	July 25	1,898	2	12	13
30	27	11	16	July 13	July 15	do	1,474	2	11	12
31	21	10	11	July 14	do	July 26	1,483	1	12	12
32	26	12	14	July 15	July 17	July 31	1,196	2	15	16
33	28	13	15	July 16	July 18	July 30	942	2	13	14
34	29	16	13	July 17	do	July 29	1,726	1	12	12
35	28	12	16	July 18	July 20	Aug. 1	1,312	2	13	14
36	33	15	18	July 19	July 21	July 31	1,042	2	11	12
37	30	14	16	July 20	July 22	Aug. 2	1,601	2	12	13
38	21	9	12	July 21	July 23	do	893	2	11	12
39	28	16	12	July 22	July 24	Aug. 5	858	2	13	14
40	12	6	6	July 23	July 26	Aug. 1	164	3	7	9
41	30	14	16	July 24	July 25	Aug. 11	771	1	18	18
42	30	19	11	July 25	July 28	Aug. 7	912	3	11	13
43	23	10	13	July 26	July 29	Aug. 5	522	3	8	10
44	18	8	10	July 27	do	Aug. 11	1,057	2	14	15
45	25	11	14	July 28	July 30	do	798	2	13	14
Total	1,166	566	600				43,821			
Average								1.80	11.00	11.80

Number of eggs per female moth.—Moths of this brood deposited a great number of eggs than did the spring-brood moths, the average being 73.04.

Length of life of moths.—The average length of life of 553 male moths was 10.17 days, of 592 female moths 9.57. (Table 15.) The

maximum length of life of the male moths was 25 days, of female moths 20; the minimum length of life of the male moths was 2 days, of female moths 3.

TABLE 15.—*Length of life of 553 male and 592 female codling moths of the first brood in captivity, Cornelia, Ga., 1920*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*			*Days*		
2	3	0	10	64	83	18	3	1
3	3	3	11	62	65	19	5	0
4	11	10	12	45	42	20	4	3
5	16	20	13	33	41	25	2	0
6	41	49	14	26	23			
7	46	69	15	26	15	Total	553	592
8	72	78	16	18	7			
9	64	77	17	9	6			

Summary of the first generation.—A summary of results from observations on the separate stages of the first generation of the codling moth shows the average length of the complete life cycle to be 44.72 days. (Table 16.)

TABLE 16.—*Summary of results from experiments on the separate stages of the first generation of the codling moth, Cornelia, Ga., 1920*

Stages of the complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	8.22	12	5
Feeding period of larvae	17.55	31	11
Making of cocoons	5.08	16	1
Pupal stage	12.07	20	6
Time before egg deposition	1.80	3	1
Total	44.72		
Length of life of male moths	10.17	25	2
Length of life of female moths	9.57	20	3
Average number of eggs per female moth, 73.04.			

THE SECOND GENERATION

EGGS OF THE SECOND BROOD

Time of deposition.—The first eggs for this brood were deposited June 23, as shown by Table 17. The period of deposition covered 50 days, during which time 43,200 eggs were observed. The time of deposition of second-brood eggs is an important date in the life of the second generation.

TABLE 17.—*Time of deposition, length of incubation, and time of hatching of 43,200 eggs of the second brood of the codling moth, Cornelia, Ga., 1920*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot	
							Days	*Days*	*Days*
1	98	June 23	June 26	June 28	June 29	98	3	5	6
2	166	June 24	June 27	June 29	June 30	166	3	5	6
3	274	June 25	June 28	June 30	July 1	274	3	5	6
4	175	June 26	June 29	July 1	July 2	161	3	5	6
5					July 3	14	3	5	7
6	259	June 27	June 30	July 1	July 2	31	3	4	5
7					July 3	228	3	4	6
8	345	Junr 28	June 30	July 1	---do-----	173	2	3	5
9					July 4	172	2	3	6
10	1,042	June 29	July 2	July 3	---do-----	208	3	4	5
11					July 5	834	3	4	6
12	998	June 30	July 2	July 4	---do-----	649	2	4	6
13					July 6	349	2	4	5
14	942	July 1	July 3	July 5	---do-----	546	2	4	6
15					July 7	396	2	4	5
16	807	July 2	July 4	July 6	---do-----	404	2	4	6
17					July 8	403	2	4	5
18	892	July 3	July 5	July 7	---do-----	223	2	4	6
19					July 9	669	2	4	5
20	1,130	July 4	July 6	July 9	July 10	1,130	2	5	6
21	931	July 5	July 7	July 10	July 11	931	2	5	5
22	1,087	July 6	July 8	July 11	July 12	1,087	2	5	6
23	1,675	July 7	July 9	July 12	July 13	1,541	2	5	6
24					July 14	134	2	5	6
25	1,558	July 8	July 10	July 13	---do-----	1,558	2	5	6
26	1,615	July 9	July 11	July 14	July 15	1,615	2	5	5
27	186	July 10	July 12	July 15	July 16	186	2	5	5
28	1,469	July 11	July 13	July 16	July 17	1,469	2	5	5
29	2,152	July 12	July 14	July 17	July 18	2,152	2	5	6
30	2,063	July 13	July 15	July 18	July 19	1,650	2	5	6
31					July 20	413	2	5	7
32	1,869	July 14	July 16	July 19	---do-----	318	2	5	6
33					July 21	1,551	2	5	7
34	1,598	July 15	July 17	July 20	---do-----	767	2	5	6
35					July 22	831	2	5	7
36	1,591	July 16	July 18	July 21	---do-----	1,289	2	5	6
37					July 23	302	2	5	7
38	807	July 17	July 19	July 22	---do-----	807	2	5	6
39	1,091	July 18	July 20	July 23	July 24	1,091	2	5	6
40	1,319	July 19	July 21	---do----	---do-----	383	2	4	5
41					July 25	936	2	4	6
42	2,263	July 20	July 22	July 24	---do-----	1,856	2	4	5
43					July 26	407	2	4	6
44	1,594	July 21	July 23	July 25	---do-----	1,259	2	4	5
45					July 27	335	2	4	6
46	1,373	July 22	July 24	July 26	---do-----	302	2	4	5
47					July 28	1,071	2	4	6
48	1,278	July 23	July 24	July 28	July 29	1,278	1	5	6
49	1,204	July 24	July 25	July 29	July 30	1,108	1	5	6
50					July 31	96	1	5	7
51	1,048	July 25	July 26	July 30	---do-----	1,048	1	5	6
52	690	July 26	July 27	July 31	Aug. 1	635	1	5	6
53					Aug. 2	55	1	5	7
54	406	July 27	July 28	Aug. 1	---do-----	394	1	5	6
55					Aug. 3	12	1	5	7
56	472	July 28	July 29	Aug. 2	---do-----	420	1	5	6
57					Aug. 4	52	1	5	7
58	578	July 29	July 30	Aug. 3	---do-----	538	1	5	6
59					Aug. 5	40	1	5	7
60	1,050	July 30	July 31	Aug. 4	---do-----	273	1	5	6
61					Aug. 6	777	1	5	7
62	808	July 31	Aug. 1	Aug. 5	---do-----	48	1	5	6
63					Aug. 7	760	1	5	7
64	926	Aug. 1	Aug. 2	Aug. 7	Aug. 8	889	1	6	7
65					Aug. 9	37	1	6	8
66	564	Aug. 2	Aug. 3	Aug. 8	---do-----	282	1	6	7
67					Aug. 10	282	1	6	8
68	243	Aug. 3	Aug. 4	Aug. 9	---do-----	182	1	6	7
69					Aug. 11	61	1	6	8
70	204	Aug. 4	Aug. 5	Aug. 10	---do----	200	1	6	7
71					Aug. 12	4	1	6	8
72	75	Aug. 5	Aug. 6	Aug. 11	---do-----	73	1	6	7

TABLE 17.—*Time of deposition, length of incubation, and time of hatching of 43,200 eggs of the second brood of the codling moth, Cornelia, Ga., 1920*—Con.

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot	
							Days	*Days*	*Days*
73					Aug. 13	2	1	6	8
74	100	Aug. 6	Aug. 8	Aug. 12	do	93	2	6	7
75					Aug. 14	7	2	6	8
76	64	Aug. 7	Aug. 9	Aug. 13	do	61	2	6	7
77					Aug. 15	3	2	6	8
78	58	Aug. 8	Aug. 10	Aug. 14	do	58	2	6	7
79	18	Aug. 9	Aug. 11	Aug. 15	Aug. 16	18	2	6	7
80	32	Aug. 10	Aug. 12	Aug. 16	Aug. 17	32	2	6	7
81	13	Aug. 11	Aug. 13	Aug. 17	Aug. 18	13	2	6	7
Total	43,200					43,200			
Average							1.83	4.77	6.04

Length of incubation.—It will be noted from Table 17 that the incubation period was very short; with but few exceptions, the incubation period of this brood was 5, 6, or 7 days. The red ring appeared about 2 days after egg deposition, and the black spot 2 days before hatching. The average time from date of deposition to the appearance of the red ring was 1.83 days, maximum 3, minimum 1; the average time of the appearance of the black spot from date of deposition was 4.77 days, maximum 6, minimum 3.

LARVAE OF THE SECOND BROOD

Time of hatching.—According to the insectary records, as given in Table 17, the second-brood eggs began to hatch on June 29, 6 days after being deposited. The hatching period continued through August 18 and covered a total of 51 days.

Length of the feeding period.—Larvae commenced entering the fruit on June 29, and the first one to complete its feeding period left the fruit July 14. The number of observations taken over a period of 51 days was very large. From the total number of 3,936 larvae observed, the average feeding period was 19.97 days, the maximum 35, and the minimum 13. (Table 18.)

TABLE 18.—*Length of feeding period of 3,936 larvae of the second brood of the codling moth, Cornelia, Ga., 1920*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																					
		13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
June 29	37			5	7	9	4	3		3	3		2	1										
June 30	70		6	5	7	11	13	10	6	3	3	4			1	1								
July 1	67		2	2	6	14	9	17	3	6	3	1	4											
July 2	69		3	4	11	9	19	8	4	4		3	3				1							
July 3	111	2	3	6	16	13	13	25	19	4	2	3			1	1			2		1			
July 4	100		3	7	16	16	18	16	13	5	5							1						
July 5	225		3	10	24	31	41	78	9	2	5	7	6	5		2			1	1				
July 6	171		2	7	17	50	56		10	8	6	3	4	3		2	2	1						
July 7	203		2	10	25	57	39	22	20	9	9	3				4		1				1		1
July 8	152			4	16	28	33	36	11	8	9	5			1	1								
July 9	106			5	18	17	21	12	14		7	3	2	1	3					3				
July 10	168			5	12	25	24	27	19	11	8	8	8	10	2	3	1	1	1			2	1	
July 11	103			2	12	14	13	18	15	12	5	5	3		1	3								
July 12	127			5	11	15	21	10	19	14	2	7	3	1	7	2	1	5	1	3				
July 13	145		3	17	22	22	23	15	13	7	7	5	6		1	1		3						
July 14	244	3		9	18	44	37	33	35	17	11	10	10	2	4	2	2	2	2	2	1			
July 15	178				4	28	33	34	34	9	10	7	3	9	1	2	2	1	1					
July 16	104			2	9	14	12	16	24	8	4	3	2	2	5	2				1				
July 17	55				3	8	11	12	2	8	3		2	4	2									
July 18	152			7	11	12	24	6	21	20	15	11	13		5	1	3	1	1	1				
July 19	134				6	9	29	9	6	24	17	6	6	8	6	4	2	1	1					
July 20	104				4	9	15	3	10	8	13	9	9	4	3		9	1	1	5	1			
July 21	125			4	5	8	14	16	18	18	10	12	8	7	4			1						
July 22	101					2	8	6	12	6	11	10	15	10		7	4	4		1	1	2	1	1
July 23	62					3	4	3	14	6	9	8	5		4		5	1						
July 24	59						8	9	10	5	9	6	2	2	3	3	1		1					
July 25	79					3	6	7	18	5	15	8	5	5	2		4	1						
July 26	87					2	7	6	15	1	16	11	6	5	3	6	4	3	2					
July 27	78						7	10	17	10	10	4	7	2	6	3	1	1						
July 28	48						3	4	8	12	5	2	5	3	2	2	2							
July 29	55						4	8	9	12	2	3	6	2	4	3				1		1		
July 30	47						3	3	11	10	4	6	5	1	1	1	1	1						
July 31	60						1	5	8	14	8	5	5	4	4	2	1	1	2					
Aug. 1	30							2	5	4	6	5	6	1		1								
Aug. 2	29						1	6	8	5	4	1	2	1	1									
Aug. 3	28					1	1	5	5	8	2	4	1	1										
Aug. 4	45					2	7	3	10	9	4	3	2	3	1			1						
Aug. 5	39					1	7	6	8	10	1	3			2	1								
Aug. 6	39						5	6	9	3	3	4	2	2				2			1			
Aug. 7	18					2	5	1	2		5	3												
Aug. 8	10							3	2			1	1		2	1								
Aug. 9	17					2	1	4	6	2	1						1							
Aug. 10	11							2	1	2	2	3	1											
Aug. 11	6								2		1	1	1				1							
Aug. 12	12							2	1		1	2	2	1	3									
Aug. 13	6							2	2			1	1											
Aug. 14	3							2					1											
Aug. 15	4								3		1													
Aug. 17	5							1			1	1		1								1		
Aug. 18	8							2	1	2	1			1				1						
Total	3,936	5	27	116	280	481	600	534	512	334	279	210	175	102	87	61	48	35	16	17	5	7	3	2

Length of the cocooning period.—The cocooning period was somewhat shorter for the first larvae which left the fruit. Table 19 shows that there was a gradual increase in the length of this period, starting at an average of 4.62 days and increasing to 13.33 days later in the season. The average for the 954 individuals was 7.59 days.

TABLE 19.—*Length of cocooning period of 954 transforming larvae of the second brood of the codling moth, Cornelia, Ga., 1920*

Larvae left fruit	Number of individuals	Number of individuals having cocooning periods [1] of specified number of days																									Average	Maximum	Minimum
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	26	29	31	34			
																												Days	*Days*	*Days*
July 14	8		1	2	4	1																						4.62	6	3
July 15	4		1		2		1																					5.00	7	3
July 16	6			6																								4.00	4	4
July 17	7				5	2																						5.29	6	5
July 18	16			9	4	1	1													1								5.56	20	4
July 19	18		2	5	6	1	1		1							1			1									6.28	19	3
July 20	22		1	5	4	3	3	1	1			2	1					1										7.00	18	3
July 21	41			12	9	6	2	6	2		1				1	1	1											6.54	17	4
July 22	56		1	13	10	6	11	5	1	3	2				1				1			1			1			7.25	31	3
July 23	80		1	8	9	13	11	10	12	3	6	1	2			1	1	1	1									7.84	19	3
July 24	83	1	2	3	19	13	12	10	3	4	3	3	2	1	4		1								1		1	8.11	34	2
July 25	52			3	10	11	9	5	6	4		1				1					2							7.60	21	4
July 26	41			4	11	6	9	2	2	2	1		1					1	1		1							7.46	21	4
July 27	71			11	23	10	5	7	3	4	1	3			2		1			1								6.92	20	4
July 28	42			9	7	7	3	3	5	2	2			1	2								1					7.43	23	4
July 29	59		4	12	8	6	8	6	2	1	3	3	3		1	1							1					7.29	23	3
July 30	51		1	5	9	10	8	7	2	6		1		1	1													7.04	15	3
July 31	45			2	5	11	3	7	5	3	4			1	2			1				1						8.42	22	4
Aug. 1	40		1		2	6	12	4	8		2					2	2		1									8.60	19	3
Aug. 2	35			6	2	5	3	3	4	3		3	3		2				1									8.54	19	4
Aug. 3	33		2	1	5	7	6	4		2	2	1		1				2										7.73	18	3
Aug. 4	25			3	2	5	4	1		1	2	4				1		2										8.80	18	4
Aug. 5	19			2	2	1	4	2	3	3		2																7.84	12	4
Aug. 6	15			1	3			4	1			1		2		1					2							10.53	21	4
Aug. 7	12	1		2	2		2	1		1			2								1							8.25	21	2
Aug. 8	7		1			3	1	1	1																			6.43	9	3
Aug. 9	13			1	2	3	1		1		1		1					1	1	1								9.69	19	4
Aug. 10	13				2	1	2	3			2	1						1	1									9.46	18	5
Aug. 11	5			1		1	1		1			1																7.60	12	4
Aug. 12	2							1								1												12.00	16	8
Aug. 13	6				2		2	1	1																			6.83	9	5
Aug. 14	2					1	1																					6.50	7	6
Aug. 15	9			1	3		1	1	2			1																7.11	12	4
Aug. 16	4				2	2																						5.50	6	5
Aug. 17	2					2																						6.00	6	6
Aug. 18	3				1				1																1			13.33	26	5
Aug. 19	2			1				1																				6.00	8	4
Aug. 20	1							1																				8.00	8	8
Aug. 21	2						1			1																		8.50	10	7
Aug. 22	1				1																							5.00	5	5
Aug. 24	1							1																				8.00	8	8
Total or average	954	2	18	128	176	144	128	98	68	43	32	28	15	7	16	10	8	10	7	2	6	2	2	1	1	1	1	7.59	------	------

[1] Time from leaving the fruit to the time of pupation.

Percentage of transforming and wintering larvae.—Of 3,926 second-brood larvae, 408 died, 939 pupated, and 2,579 wintered. This shows that 65.7 per cent wintered, 23.9 per cent transformed, and 10.4 per cent died.

PUPAE OF THE SECOND BROOD

Time of pupation.—The first pupation occurred on July 17 and the last on September 1. Actual pupations are thus shown to cover a period of 47 days. (Table 20.)

TABLE 20.—*Time of pupation of 939 transforming larvae of the second brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
July 17	1	July 30	43	Aug. 11	30	Aug. 23	6
July 18	3	July 31	54	Aug. 12	15	Aug. 24	2
July 19	4	Aug. 1	75	Aug. 13	11	Aug. 26	1
July 20	9	Aug. 2	55	Aug. 14	25	Aug. 27	9
July 22	18	Aug. 3	44	Aug. 15	21	Aug. 28	6
July 23	12	Aug. 4	41	Aug. 16	7	Aug. 31	1
July 24	11	Aug. 5	35	Aug. 17	10	Sept. 1	1
July 25	19	Aug. 6	48	Aug. 18	11		
July 26	28	Aug. 7	29	Aug. 19	1	Total	939
July 27	29	Aug. 8	43	Aug. 20	17		
July 28	22	Aug. 9	34	Aug. 21	9		
July 29	54	Aug. 10	34	Aug. 22	11		

Length of the pupal stage.—From a total of 838 individual pupae under observation, the results show that the pupal period varied from 7 to 20 days, with an average of 12.49 days, as shown in Table 21.

TABLE 21.—*Length of the pupal stage of 838 pupae of the second brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days												
		7	8	9	10	11	12	13	14	15	16	17	19	20
July 18	3				1	2								
July 19	4				2	2								
July 20	6				3	2	1							
July 22	18				10	6	2							
July 23	11				1	4	6							
July 24	12			3		4	4	1						
July 25	17					2	8	5	1	1				
July 26	26				2	3	8	9	3		1			
July 27	28	1		1	1	4	15	5	1					
July 28	23						10	9	4					
July 29	53					8	25	16	4					
July 30	41				1	1	9	24	5	1				
July 31	52					2	16	26	6	2				
Aug. 1	71			1	2	2	14	29	21	2				
Aug. 2	46			2		3	8	15	16	1				1
Aug. 3	36			1	1	3	6	14	8	1	1		1	
Aug. 4	34						4	19	11					
Aug. 5	30					2	6	16	5			1		
Aug. 6	40		1	1		1	16	12	8	1				
Aug. 7	21					1	6	13	1					
Aug. 8	37				1	1	23	11	1					
Aug. 9	31				1	4	15	11						
Aug. 10	31			1			17	12	1					
Aug. 11	24					8	6	8	1	1				
Aug. 12	13					3	4	6						
Aug. 13	9			1		2	1	5						
Aug. 14	21	1	1	1			11	3	3		1			
Aug. 15	16	1		2		1	4	4	2	2				
Aug. 16	8						5	2	1					
Aug. 17	9						4	2	3					
Aug. 18	8						5	3						
Aug. 19	1							1						
Aug. 20	18				1	6	6	5						
Aug. 21	9					1	2		3	2	1			
Aug. 22	9		1	2	1	1		1	2	1				
Aug. 23	2							1	1					
Aug. 24	2					1		1						
Aug. 26	1				1									
Aug. 27	9				1		2	1	4	1				
Aug. 28	5							2	1	1	1			
Aug. 31	1								1					
Sept. 1	1									1				
Sept. 13	1							1						
Total	838	3	3	16	30	80	269	293	118	18	5	1	1	1

MOTHS OF THE SECOND BROOD

Time of emergence.—Moths of this brood commenced to emerge on July 28 and the emergence period extended over two months to September 26. These moths issued from insectary material, and the number emerging (882) was small as compared with the first brood. (Table 22.)

TABLE 22.—*Time of emergence of 882 codling moths of the second brood, from material reared at the insectary, Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
July 28	2	Aug. 10	40	Aug. 23	25	Sept. 5	5
July 29	5	Aug. 11	36	Aug. 24	17	Sept. 6	6
July 30	5	Aug. 12	50	Aug. 25	7	Sept. 7	1
July 31	2	Aug. 13	50	Aug. 26	17	Sept. 8	3
Aug. 1	12	Aug. 14	50	Aug. 27	9	Sept. 9	2
Aug. 2	8	Aug. 15	47	Aug. 28	12	Sept. 10	6
Aug. 3	8	Aug. 16	43	Aug. 29	8	Sept. 11	2
Aug. 4	11	Aug. 17	37	Aug. 30	15	Sept. 13	1
Aug. 5	8	Aug. 18	50	Aug. 31	13	Sept. 14	2
Aug. 6	14	Aug. 19	31	Sept. 1	8	Sept. 16	1
Aug. 7	17	Aug. 20	52	Sept. 2	10	Sept. 26	1
Aug. 8	27	Aug. 21	27	Sept. 3	1		
Aug. 9	26	Aug. 22	44	Sept. 4	8	Total	882

Time of oviposition.—The moths generally began depositing eggs about two days after emergence, the average time being 2.36 days, the maximum 9 days and the minimum 1 day. The length of the oviposition period ranged from 1 to 18 days, with an average of 10.9 days. The length of time from the emergence of the moths to the last deposition varied from 6 to 19 days, with an average of 12.25 days.

TABLE 23.—*Oviposition by 417 codling moths of the second brood in rearing cages, Cornelia, Ga., 1920*

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
0	2	1	1	July 28	July 30		1,327			
	5	3	2	July 29						
	5	2	3	July 30						
	2		2	July 31						
1	11	6	5	Aug. 1	Aug. 3	Aug. 13	724	2	11	12
2	8	2	6	Aug. 2	Aug. 4	Aug. 18	718	2	15	16
3	5	2	3	Aug. 3	Aug. 5	Aug. 13	521	2	9	10
4	10	5	5	Aug. 4	Aug. 6	Aug. 15	592	2	10	11
5	8	4	4	Aug. 5	Aug. 7	Aug. 14	521	2	8	9
6	11	4	7	Aug. 6	do	Aug. 16	633	1	10	10
7	16	4	12	Aug. 7	Aug. 9	Aug. 22	1,124	2	14	15
8	25	8	17	Aug. 8	do	Aug. 19	2,477	1	11	11
9	21	10	11	Aug. 9	Aug. 12	Aug. 18	974	3	7	9
10	33	14	19	Aug. 10	do	Aug. 24	1,709	2	13	14
11	31	17	14	Aug. 11	Aug. 13	Aug. 21	734	2	9	10
12	19	7	12	Aug. 12	Aug. 15	Aug. 23	1,190	3	9	11
13	18	8	10	do	do	Aug. 22	1,198	3	8	10
14	22	7	15	Aug. 13	do	Aug. 25	1,515	2	11	12
15	20	12	8	do	do	Aug. 26	663	2	12	13
16	24	11	13	Aug. 14	Aug. 16	Aug. 24	1,063	2	9	10
17	18	8	10	do	do	do	612	2	9	10
18	18	7	11	Aug. 15	Aug. 18	Aug. 22	469	3	5	7

TABLE 23.—*Oviposition by 417 codling moths of the second brood in rearing cages, Cornelia, Ga., 1920*—Continued

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
19	22	9	13	Aug. 15	Aug. 18	Aug. 21	360	3	4	6
20	20	11	9	Aug. 16	do	Aug. 26	693	2	9	10
21	23	13	10	do	do	Aug. 29	563	2	12	13
22	18	9	9	Aug. 17	Aug. 19	Sept. 1	795	2	14	15
23	18	3	15	do	do	Sept. 2	884	2	15	16
24	19	8	11	Aug. 18	Aug. 20	do	712	2	14	15
25	19	5	14	do	do	Sept. 1	1,208	2	13	14
26	27	14	13	Aug. 19	Aug. 21	do	872	8	12	19
27	29	10	19	Aug. 20	Aug. 22	Sept. 3	2,152	2	13	14
28	28	13	15	Aug. 21	Aug. 23	Sept. 5	1,542	2	14	15
29	30	13	17	Aug. 22	Aug. 24	Sept. 10	1,455	2	18	19
30	24	11	13	Aug. 23	Aug. 25	Sept. 6	1,205	2	13	14
31	15	7	8	Aug. 24	Aug. 26	Aug. 31	774	2	6	7
32	7	1	6	Aug. 25	Aug. 27	Sept. 3	301	2	8	9
33	12	5	7	Aug. 26	Aug. 28	do	545	2	7	8
34	6	3	3	Aug. 27	Aug. 29	do	286	2	6	7
35	12	6	6	Aug. 28	Aug. 30	Sept. 4	421	2	6	7
36	7	4	3	Aug. 29	Aug. 31	Sept. 8	74	2	9	10
37	12	6	6	Aug. 30	Sept. 1	Sept. 13	735	2	13	14
38	7	5	2	Aug. 31	Sept. 2	Sept. 7	60	2	6	7
39	6	4	2	Sept. 1	Sept. 10	Sept. 10	1	9	1	9
40	11	8	3	Sept. 2	Sept. 5	Sept. 15	241	3	11	13
41	1	1		Sept. 3						
42	10	6	4	Sept. 4	Sept. 6	Sept. 15	262	2	10	11
43	8		8	Sept. 5	Sept. 8	Sept. 21	68	3	14	16
44	3	1	2	Sept. 6	do	Sept. 19	293	2	12	13
45	2		2	Sept. 7	Sept. 11	Sept. 13	137	4	3	6
46	4	4		Sept. 8						
47	1	1		Sept. 9						
48	6	3	3	Sept. 10	Sept. 12	Sept. 21	61	2	10	11
49	2	1	1	Sept. 11	Sept. 14	do	107	3	8	10
50	1	1		Sept. 12						
51	1	1		Sept. 13						
52	2		2	Sept. 14	Sept. 18	Sept. 21	122	4	4	7
53	1		1	Sept. 16						
Total	746	329	417				35,693			
Average								2.36	10.90	12.25

Number of eggs per female moth.—The number of eggs deposited per female moth was large. The average number of eggs for 417 female moths was 85.59. In cage 0, which contained 8 females, the number of eggs laid was 1,327. In cage 8, which contained 17 females, the number of eggs laid was 2,477. In cage 3, containing 3 females, 521 eggs were deposited. (Table 23.)

Length of life of moths.—The length of life of 732 moths, of which 323 were males and 409 females, was recorded. The male moths lived an average of 10.35 days, the females 10.23. The maximum length of life of the male moths was 27 days, of female moths 24; the minimum length of life of male moths was 3 days, of female moths 2. (Table 24.)

TABLE 24.—*Length of life of 323 male and 409 female codling moths of the second brood in captivity, Cornelia, Ga., 1920*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*			*Days*		
2	0	2	11	43	39	20	5	3
3	11	2	12	29	31	21	3	3
4	7	7	13	15	16	22	1	0
5	14	14	14	14	15	23	0	1
6	21	23	15	13	18	24	2	1
7	16	34	16	9	12	27	1	0
8	32	47	17	5	11			
9	40	64	18	2	4	Total	323	409
10	37	60	19	3	2			

Summary of the second generation.—A summary of results from observations on the separate stages of the second generation of the codling moth shows the length of the complete life cycle to be 48.45 days. (Table 25.)

TABLE 25.—*Summary of results from experiments on the separate stages of the second generation of the codling moth, Cornelia, Ga., 1920*

Stages of the complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	6.04	8	5
Feeding period of larvae	19.97	35	13
Making of cocoons	7.59	34	2
Pupal stage	12.49	20	7
Time before egg deposition	2.36	9	1
Total	48.45		
Length of life of male moths	10.35	27	3
Length of life of female moths	10.23	24	2
Average number of eggs per female moth, 85.59.			

THE THIRD GENERATION

EGGS OF THE THIRD BROOD

Time of deposition.—Deposition of the third-brood eggs began on July 30 and ended on September 21. The maximum deposition occurred on August 16. The deposition period lasted more than seven weeks, and eggs were laid in great abundance almost every day during this period. (Table 26.)

TABLE 26.—*Time of deposition, length of incubation, and time of hatching of 34,375 eggs of the third brood of the codling moth, Cornelia, Ga., 1920*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot	
							Days	*Days*	*Days*
1	45	July 30	July 31	Aug. 4	Aug. 5	7	1	5	6
2		do	do	do	Aug. 6	38	1	5	7
3	35	July 31	Aug. 1	Aug. 5	Aug. 7	35	1	5	7
4	212	Aug. 1	Aug. 2	Aug. 7	Aug. 8	197	1	6	7
5					Aug. 9	15	1	6	8
6	313	Aug. 2	Aug. 3	Aug. 8	do	156	1	6	7
7					Aug. 10	157	1	6	8
8	227	Aug. 3	Aug. 4	Aug. 9	do	170	1	6	7
9					Aug. 11	57	1	6	8
10	404	Aug. 4	Aug. 5	Aug. 10	do	323	1	6	7
11					Aug. 12	81	1	6	8
12	197	Aug. 5	Aug. 6	Aug. 11	do	193	1	6	7
13					Aug. 13	4	1	6	8
14	486	Aug. 6	Aug. 8	Aug. 12	do	477	2	6	7
15					Aug. 14	9	2	6	8
16	688	Aug. 7	Aug. 9	Aug. 13	do	675	2	6	7
17					Aug. 15	13	2	6	8
18	247	Aug. 8	Aug. 10	Aug. 14	do	247	2	6	7
19	626	Aug. 9	Aug. 11	Aug. 15	Aug. 16	626	2	6	7
20	739	Aug. 10	Aug. 12	Aug. 16	Aug. 17	739	2	6	7
21	711	Aug. 11	Aug. 13	Aug. 17	Aug. 18	654	2	6	7
22					Aug. 19	57	2	6	8
23	1,105	Aug. 12	Aug. 14	Aug. 17	Aug. 18	88	2	5	6
24					Aug. 19	1,017	2	5	7
25	1,137	Aug. 13	Aug. 15	Aug. 18	do	592	2	5	6
26					Aug. 20	545	2	5	7
27	1,057	Aug. 14	Aug. 16	Aug. 19	do	825	2	5	6
28					Aug. 21	232	2	5	7
29	1,375	Aug. 15	Aug. 17	Aug. 20	do	1,155	2	5	6
30					Aug. 22	220	2	5	7
31	2,285	Aug. 16	Aug. 17	Aug. 21	do	2,057	1	5	6
32					Aug. 23	228	1	5	7
33	713	Aug. 17	Aug. 18	Aug. 22	do	613	1	5	6
34					Aug. 24	100	1	5	7
35	2,283	Aug. 18	Aug. 19	Aug. 23	do	2,032	1	5	6
36					Aug. 25	251	1	5	7
37	1,734	Aug. 19	Aug. 20	Aug. 24	do	1,561	1	5	6
38					Aug. 26	173	1	5	7
39	1,484	Aug. 20	Aug. 21	Aug. 25	do	1,247	1	5	6
40					Aug. 27	237	1	5	7
41	1,821	Aug. 21	Aug. 22	Aug. 26	do	237	1	5	6
42					Aug. 28	1,584	1	5	7
43	1,528	Aug. 22	Aug. 23	Aug. 27	do	199	1	5	6
44					Aug. 29	1,329	1	5	7
45	1,444	Aug. 23	Aug. 24	Aug. 29	Aug. 30	1,444	1	6	7
46	1,126	Aug. 24	Aug. 25	Aug. 30	Aug. 31	1,126	1	6	7
47	1,325	Aug. 25	Aug. 26	do	do	199	1	5	6
48					Sept. 1	1,126	1	5	7
49	1,333	Aug. 26	Aug. 27	Aug. 31	do	773	1	5	6
50					Sept. 2	560	1	5	7
51	665	Aug. 27	Aug. 28	Sept. 1	do	578	1	5	6
52					Sept. 3	87	1	5	7
53	1,204	Aug. 28	Aug. 29	Sept. 2	do	1,132	1	5	6
54					Sept. 4	72	1	5	7
55	1,329	Aug. 29	Aug. 30	Sept. 3	Sept. 5	1,170	1	5	7
56					Sept. 6	159	1	5	8
57	1,149	Aug. 30	Aug. 31	Sept. 5	do	897	1	6	7
58					Sept. 7	252	1	6	8
59	758	Aug. 31	Sept. 1	Sept. 6	do	83	1	6	7
60					Sept. 8	675	1	6	8
61	431	Sept. 1	Sept. 2	Sept. 3	Sept. 9	418	1	2	8
62					Sept. 10	13	1	2	9
63	199	Sept. 2	Sept. 3	Sept. 9	do	193	1	7	8
64					Sept. 11	6	1	7	9
65	28	Sept. 3	Sept. 5	Sept. 10	do	28	2	7	8
66	60	Sept. 4	Sept. 6	do	do	60	2	6	7
67	39	do	do	do	Sept. 12	39	2	6	8
68	159	Sept. 5	Sept. 7	do	do	159	2	5	7
69	191	Sept. 6	Sept. 8	Sept. 12	Sept. 13	191	2	6	7
70	185	Sept. 7	Sept. 9	Sept. 13	Sept. 14	185	2	6	7
71	109	Sept. 8	Sept. 10	do	do	109	2	5	6
72	125	Sept. 9	Sept. 11	Sept. 14	Sept. 15	125	2	5	6
73	246	Sept. 10	Sept. 12	Sept. 15	Sept. 16	246	2	5	6

TABLE 26.—*Time of deposition, length of incubation, and time of hatching of 34,375 eggs of the third brood of the codling moth, Cornelia, Ga., 1920*—Continued

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot	
							Days	*Days*	*Days*
74	272	Sept. 11	Sept. 12	Sept. 16	Sept. 17	272	1	5	6
75	137	Sept. 12	Sept. 13	Sept. 17	Sept. 18	137	1	5	6
76	116	Sept. 13	Sept. 14	Sept. 18	Sept. 19	116	1	5	6
77	6	do	do	do	Sept. 20	6	1	5	7
78	16	Sept. 14	Sept. 15	Sept. 19	do	16	1	5	6
79	34	do	do	do	Sept. 21	34	1	5	7
80	5	Sept. 15	Sept. 16	Sept. 20	do	5	1	5	6
81	30			Sept. 22	Sept. 22	30	1	7	7
82	5	Sept. 16	Sept. 17	do	Sept. 23	5	1	6	7
83	8	do	do	Sept. 23	Sept. 24	8	1	7	8
84	2	Sept. 17	Sept. 18	do	do	2	1	6	7
85	8	do	do	Sept. 24	Sept. 25	8	1	7	8
86	67	Sept. 18	Sept. 19	Sept. 25	do	67	1	7	7
87	81	Sept. 19	Sept. 20	do	Sept. 26	81	1	6	7
88	4	do	do	Sept. 26	Sept. 27	4	1	7	8
89	25	Sept. 20	Sept. 21	do	do	25	1	6	7
90	2	do	do	do	Sept. 28	2	1	5	7
Total	34,375					34,375			
Average							1.27	5.27	6.65

Length of incubation.—The first of the larvae hatched on August 5, which was 6 days after the eggs were deposited. The average length of the incubation period of 34,375 eggs, as shown by Table 26, was 6.65 days. The red ring appeared, on the average, 1.27 days after deposition, the black spot 5.27 days after deposition.

LARVAE OF THE THIRD BROOD

Time of hatching.—The hatching of third-brood larvae commenced on August 5 and continued until September 28. The temperature during this time was normal, and the eggs were very regular in hatching. The maximum hatching occurred about August 24.

Length of the feeding period.—Table 27 shows a variation in the feeding period of 968 third-brood larvae of from 16 to 44 days, with an average period of 23.3 days. During August the first larvae of this brood to enter the fruit completed their growth in a shorter period than the last larvae which entered the fruit.

Time of leaving the fruit.—One of the first larvae of this brood left the fruit August 24, the last October 30.

TABLE 27.—*Length of feeding period of 968 larvae of the third brood of the codling moth, stock-jar method, Cornelia, Ga., 1920*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																												
		16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	44
Aug. 5	3				1			1								1													
Aug. 6	17			1	1	1	4	1	3	2	2		1						1									
Aug. 7	14			1	4	5			1	1	1		1															
Aug. 8	43		1	5	4	9	6	4	3	2	2	1	1			3				2								
Aug. 9	39	1	1		1	2	2	5	7	4	4	1	5	2		2				1	1							
Aug. 10	24			3	1	5	2	5	1	3			1		1	1			1									
Aug. 11	33			1	2	2	9	4	2	5	1		3	1			2		1									
Aug. 12	24			1	1	5	7	2			3		2	1			1		1									
Aug. 13	24			1	4	7	2	1		1	3				2	1		1	1									
Aug. 14	48			4	5	2	3	8	5	2	6	6	2	1	2	2												
Aug. 15	29				6	1	5	4	3		3	3	1	2			1											
Aug. 16	14				1	1	2	1		4	1	1			1	1	1											
Aug. 17	33		1		2	6	5	6	5	4	1		3															
Aug. 18	12				2		1	3	3			1		2														
Aug. 19	25				4	9	4	3	2	1	1	1																
Aug. 20	13				3	1	2	3	3								1											
Aug. 21	8					3			2	1	2																	
Aug. 22	3			1		2																						
Aug. 23	3				1	1		1																				
Aug. 25	2					1						1																
Aug. 26	13								4	8	1																	
Aug. 27	19						9	4	1	1	1				1	2												
Aug. 28	28					7	5	4		3	5		2	1	1													
Aug. 29	19				4	6	4	2	2		1																	
Aug. 30	32			5	1	7	4	3	4	2		1		2		1		1		1								
Aug. 31	35		3	5	7	2	4	2	1	4	2	3	1				1											
Sept. 1	16	2	4	5		1	2		2																			
Sept. 2	35		2	6	8		5	5	3	3						1		1			1							
Sept. 3	13		1	1	4	1	1	3							1						1							
Sept. 4	36	1	3	6	1	8	9	2	1				3	1		1												
Sept. 5	43	2	4	7	4	5	7	6	1	1				1	1		1			1		1		1			1	
Sept. 6	28	2	2	3	9	5	2						1		1			2	1									
Sept. 7	35	1	3	3	10	4	2	2				1	2	2			1	2	1	1								
Sept. 8	19	1	2	3	3		4	1		1		1				1		1			1							
Sept. 9	17			1	1	2	3		1	1		1			1	2	2							2				
Sept. 10	21	1	1	2		1		3	2	3	3	3	1													1		
Sept. 11	9		2	4					1	1					1													
Sept. 12	15			2				2		1	2		2	3	1			1						1				
Sept. 13	14		1					4	2	1		3	1	1			1											
Sept. 14	16			1		1	4	1	1		3	2	1		1				1									
Sept. 15	12					1		2		1	1	3	1		2					1								
Sept. 16	23					1	1		1	2	2	1	3	4		1		2	1		1				2			1
Sept. 17	6							1		1			2		1	1												
Sept. 18	8								2	1	1		1	1				1		1								
Sept. 19	16									2	1	2	2		2	1	1	3	1			1						
Sept. 20	3										1	1	1															
Sept. 21	4														1				2					1				
Sept. 22	7								1	2		2	1										1					
Sept. 23	3										1			1	1													
Sept. 24	3								1	1			1															
Sept. 25	1											1																
Sept. 26	7										1		2	3		1												
Sept. 27	1												1															
Total	968	2	16	52	87	119	110	122	91	70	62	44	50	30	23	22	13	17	13	2	7	4	2	2	3	2	1	1	1

Length of the cocooning period.—Very few of the larvae of this brood transformed. Table 28 gives the record of 13 larvae. The average for these larvae was 7.31 days, the maximum 16, and the minimum 3.

TABLE 28.—*Length of cocooning period of 13 transforming larvae of the third brood of the codling moth, Cornelia, Ga., 1920*

Larvae left fruit	Number of individuals	Number of individuals having cocooning periods [1] of specified number of days							Average	Maximum	Minimum
		3	4	5	7	9	13	16			
									Days	*Days*	*Days*
Sept. 2	1			1					5.00	5	5
Sept. 4	1		1						4.00	4	4
Sept. 7	1	1							3.00	3	3
Sept. 8	2			2					5.00	5	5
Sept. 13	1			1					5.00	5	5
Sept. 16	1						1		13.00	13	13
Sept. 20	1				1				7.00	7	7
Sept. 24	1					1			9.00	9	9
Sept. 25	1			1					5.00	5	5
Sept. 26	2					1		1	12.50	16	9
Oct. 2	1					1			9.00	9	9
Total or average	13	1	1	5	1	3	1	1	7.31		

[1] Time from leaving the fruit to the time of pupation.

Percentage of transforming larvae.—Of the 968 larvae, only 13, or 1.34 per cent, transformed to pupae. This leaves 98.66 per cent wintering.

PUPAE OF THE THIRD BROOD

Time of pupation.—Pupation of the third brood occurred from September 7 to October 11. (Table 29.)

TABLE 29.—*Time of pupation of 13 transforming larvae of the third brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
Sept. 7	1	Sept. 13	2	Sept. 27	1	Oct. 5	1
Sept. 8	1	Sept. 16	1	Sept. 30	1	Oct. 11	2
Sept. 10	1	Sept. 18	1	Oct. 3	1	Total	13

Length of the pupal stage.—In Table 30 the length of the pupal stage of 12 pupae of the third brood is given. The average was 16.17 days, the maximum 21, and the minimum 12.

TABLE 30.—*Length of the pupal stage of 12 pupae of the third brood of the codling moth, Cornelia, Ga., 1920*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days							
		12	14	15	16	17	19	20	21
Sept. 7	1		1						
Sept. 8	1				1				
Sept. 10	1		1						
Sept. 13	2			1	1				
Sept. 16	1	1							
Sept. 18	1			1					
Sept. 30	1						1		
Oct. 3	1							1	
Oct. 5	1					1			
Oct. 11	2			1					1
Total	12	1	2	3	2	1	1	1	1

MOTHS OF THE THIRD BROOD

Time of emergence.—The time of the emergence of 12 moths of the third brood is presented in Table 31. The first of these moths issued September 10 and the last November 1. These moths were from the insectary-reared material.

TABLE 31.—*Time of emergence of 12 codling moths of the third brood, Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
Sept. 10	1	Sept. 29	1	Oct. 23	1
Sept. 21	1	Oct. 3	1	Oct. 26	1
Sept. 24	1	Oct. 19	1	Nov. 1	1
Sept. 28	2	Oct. 22	1	Total	12

Oviposition.—Only one moth of this brood oviposited. Eleven moths, as they emerged daily, were placed in separate cages for the individual length-of-life records. If all moths had been caged together, no doubt more eggs would have been deposited. The 80 eggs were produced by a moth which emerged on September 24. The first eggs were deposited on September 28 and the last on October 4.

Length of life of moths.—Observations on the length of the life of 11 moths are shown in Table 32. The average life of the 4 male moths was 11.5 days, of the 7 female moths 12.14 days. The maximum length of life of the male moths was 13 days, of female moths 19. The minimum length of life of the male moths was 10 days, of female moths 5.

TABLE 32.—*Length of life of 4 male and 7 female codling moths of the third brood in captivity, Cornelia, Ga., 1920*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*		
5	0	1	15	0	1
7	0	1	18	0	1
10	1	1	19	0	1
11	1	1			
12	1	0	Total	4	7
13	1	0			

Summary of the third generation.—A summary of results from observations on the separate stages of the third generation of the codling moth shows the length of the complete life cycle to be 57.43 days. (Table 33.)

TABLE 33.—*Summary of results from experiments on the separate stages of the third generation of the codling moth, Cornelia, Ga., 1920*

Stages of the complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	6.65	9	6
Feeding period of larvae	23.30	44	16
Making of cocoons	7.31	16	3
Pupal stage	16.17	21	12
Time before egg deposition	4.00	4	4
Total	57.43		
Length of life of male moths	11.50	13	10
Length of life of female moths	12.14	19	5

THE FOURTH GENERATION

EGGS OF THE FOURTH BROOD

Time of deposition.—As shown in Table 34, eggs of this brood were deposited on September 28, October 3, and October 4. The eggs were deposited by one moth in a cage which did not contain any male moths; therefore all the eggs were infertile, and further records were not completed.

TABLE 34.—*Time of deposition of 80 eggs of the fourth brood of the codling moth, Cornelia, Ga., 1920*

Observation No.	Number of eggs	Date deposited
1	50	Sept. 28.
2	17	Oct. 3.
3	13	Oct. 4.
Total	80	

BAND-RECORD EXPERIMENTS OF 1920

Band-record experiments were conducted in five widely separated, unsprayed apple orchards. Long before the first worms left the fruit, the trees were prepared for the bands. The rough bark scales were removed, all holes and crotches of the trees filled with cement, rubbish was cleaned away from beneath the trees, and a burlap band was placed around the trunk of the trees, being held in place by a nail. These bands were examined every third day, and each collection of larvae was placed in a separate cage. The apple trees were of a late fall variety.

ORCHARDS IN CORNELIA

Table 36 shows the results obtained from the Cornelia band records. The trees, located within two blocks of the laboratory, were 11 in number. Of these trees 6 were located in a small valley on the farm of Mr. Turpin, the remainder were located on the property of Mr. Purdy, on the outskirts of the town of Cornelia.

A total of 1,596 larvae (fig. 4) were collected from these trees, from which 708 moths, or 44.36 per cent, emerged in 1920, 282 moths, or 17.67 per cent, emerged in 1921, 7.02 per cent were parasitized, and

30.95 per cent were either killed during handling or died of natural causes. (Table 35.)

Figure 4 shows that the first of the first-brood larvae left the fruit June 8, the same day on which the first of the first-brood larvae left the fruit in the insectary. The majority of the first-brood larvae left the fruit during the last half of July. The maximum number of the second-brood larvae left the fruit on August 13. Larvae continued to leave the fruit until October 15.

TABLE 35.—*Data of 1,596 codling-moth larvae collected from bands at Cornelia, Ga., 1920*

Date of collection, 1920	Collection No.	Larvae collected	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1921	Parasites emerging, 1921	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Dead individuals, 1920
		Number	*Number*	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
June 8	1	8	7		1		87.50		12.50		
June 11	2	13	10				76.92				23.08
June 14	3	45	37		2		82.23		4.44		13.33
June 17	4	79	56		6		70.89		7.59		21.52
June 20	5	38	20				52.63				47.37
June 23	6	60	55		1		91.67		1.66		6.67
June 26	7	34	29				85.29				14.71
June 29	8	79	62	2	5		78.48	2.53	6.33		12.66
July 2	9	60	53	1	3		88.33	1.67	5.00		5.00
July 5	10	75	63	1	2		84.00	1.33	2.67		12.00
July 8	11	56	33	3	2		58.93	5.36	3.57		32.14
July 11	12	46	35	1			76.09	2.17			21.74
July 14	13	33	24		1		72.73		3.03		24.24
July 17	14	36	26	4			72.22	11.11			16.67
July 20	15	29	21	1			72.41	3.45			24.14
July 23	16	9	7				77.78				22.22
July 26	17	51	36	4			70.59	7.84			21.57
July 29	18	58	37	10	3		63.80	17.24	5.17		13.79
Aug. 1	19	104	55	9	10	6	52.88	8.65	9.62	5.77	23.08
Aug. 4	20	82	20	22	3	3	24.39	26.83	3.66	3.66	41.46
Aug. 7	21	91	12	28	6	13	13.19	30.77	6.59	14.29	35.16
Aug. 10	22	92	5	41	7	11	5.43	44.57	7.61	11.96	30.43
Aug. 13	23	111	2	35		5	1.80	31.53		4.51	62.16
Aug. 16	24	32		10	1	1		31.25	3.13	3.12	62.50
Aug. 19	25	38	2	16	1		5.26	42.11	2.63		50.00
Aug. 22	26	25		7		2		28.00		8.00	64.00
Aug. 25	27	18		3		1		16.67		5.55	77.78
Aug. 28	28	23		13				56.52			43.48
Aug. 31	29	18		5		4		27.78		22.22	50.00
Sept. 3	30	24		9				37.50			62.50
Sept. 6	31	20	1	8		1	5.00	40.00		5.00	50.00
Sept. 9	32	10		3				30.00			70.00
Sept. 12	33	19		10				52.63			47.37
Sept. 15	34	14		3				21.43			78.57
Sept. 18	35	15		5		5		33.33		33.33	33.34
Sept. 21	36	13		10		1		76.92		7.69	15.39
Sept. 24	37	10		2		2		20.00		20.00	60.00
Sept. 27	38	11		5		1		45.45		9.09	45.46
Sept. 30	39	8		4		2		50.00		25.00	25.00
Oct. 3	40	2		2				100.00			
Oct. 6	41	4		3				75.00			25.00
Oct. 9	42	1									100.00
Oct. 12	43	1		1				100.00			
Oct. 15	44	1		1				100.00			
Total		1,596	708	282	54	58					
Average							44.36	17.67	3.38	3.63	30.95

Time of emergence of codling moths from band-collected material.—The first moths emerged on June 21; moths continued to emerge almost daily until August 29, and one moth emerged on September 24. The maximum number, 32 moths, issued July 12. The total number of moths emerging from this material was 708. (Table 36 and fig. 5.)

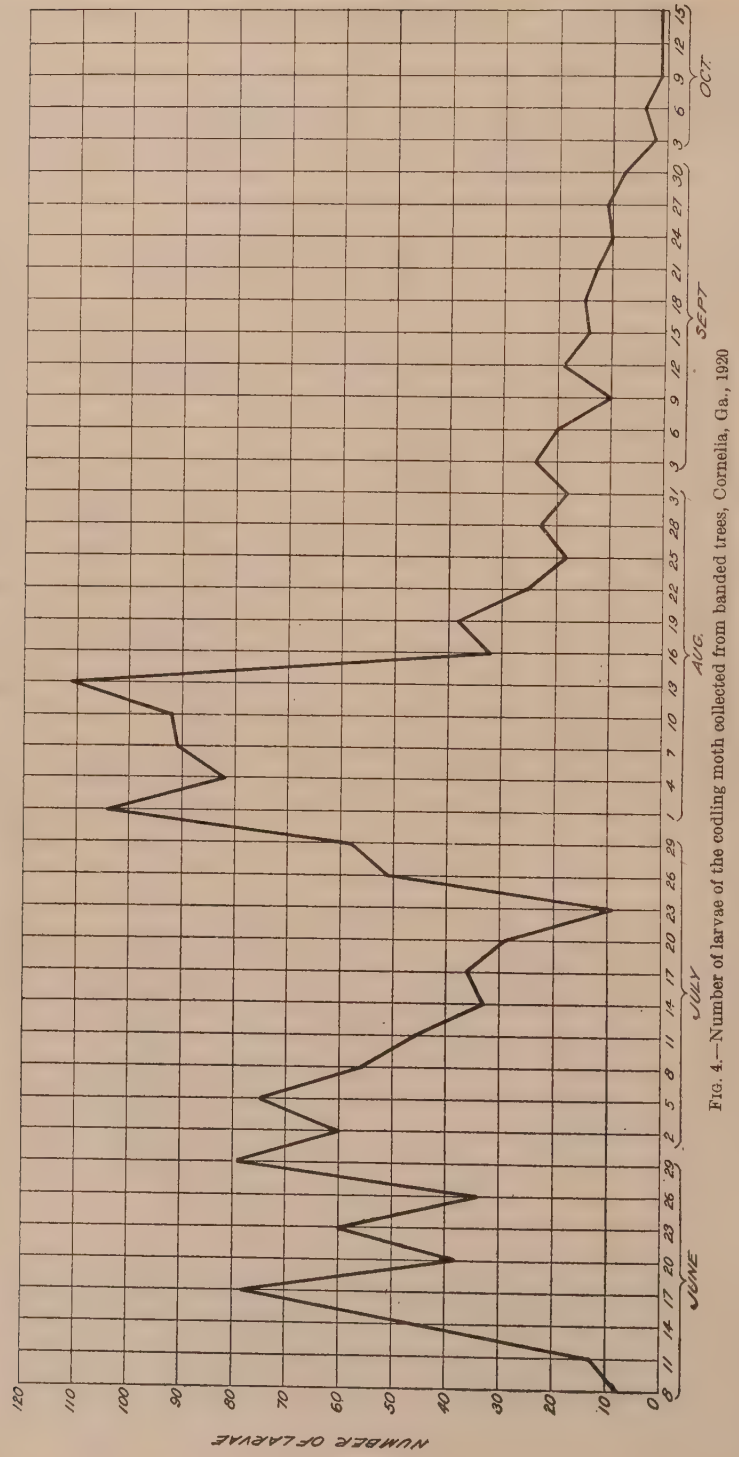

FIG. 4.—Number of larvae of the codling moth collected from banded trees, Cornelia, Ga., 1920

TABLE 36.—*Emergence of 708 codling moths from band-record material collected at Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 21	6	July 9	10	July 27	9	Aug. 15	7
June 22	1	July 10	9	July 28	15	Aug. 16	20
June 23	3	July 11	7	July 29	8	Aug. 17	23
June 24	4	July 12	32	July 30	12	Aug. 18	4
June 25	1	July 13	10	July 31	5	Aug. 19	8
June 26	4	July 14	21	Aug. 1	8	Aug. 20	6
June 27	8	July 15	26	Aug. 2	8	Aug. 21	2
June 28	14	July 16	15	Aug. 3	4	Aug. 22	8
June 29	8	July 17	6	Aug. 4	2	Aug. 23	3
June 30	7	July 18	17	Aug. 5	4	Aug. 24	3
July 1	23	July 19	23	Aug. 6	6	Aug. 25	3
July 2	27	July 20	19	Aug. 8	5	Aug. 26	4
July 3	9	July 21	6	Aug. 9	8	Aug. 28	3
July 4	15	July 22	15	Aug. 10	14	Aug. 29	1
July 5	4	July 23	7	Aug. 11	8	Sept. 24	1
July 6	28	July 24	17	Aug. 12	14		
July 7	18	July 25	14	Aug. 13	12	Total	708
July 8	13	July 26	9	Aug. 14	14		

THE DUNSON ORCHARD

The Dunson orchard is located 9 miles northeast of Cornelia. Fourteen trees were selected, and all were of a late fall variety. The

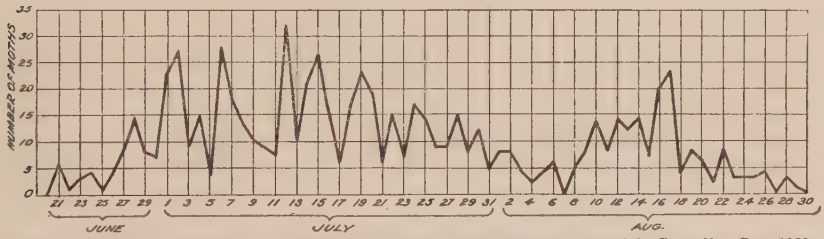

FIG. 5.—Time of emergence of codling moths from hand-collected material, Cornelia, Ga., 1920. (One moth emerged on September 24)

experiments were not started in time to secure the first larvae which left the fruit, but the maximum number leaving the fruit for each brood was registered and also the beginning of each brood except the first. The results are shown in Tables 37 and 38 and Figures 6 and 7.

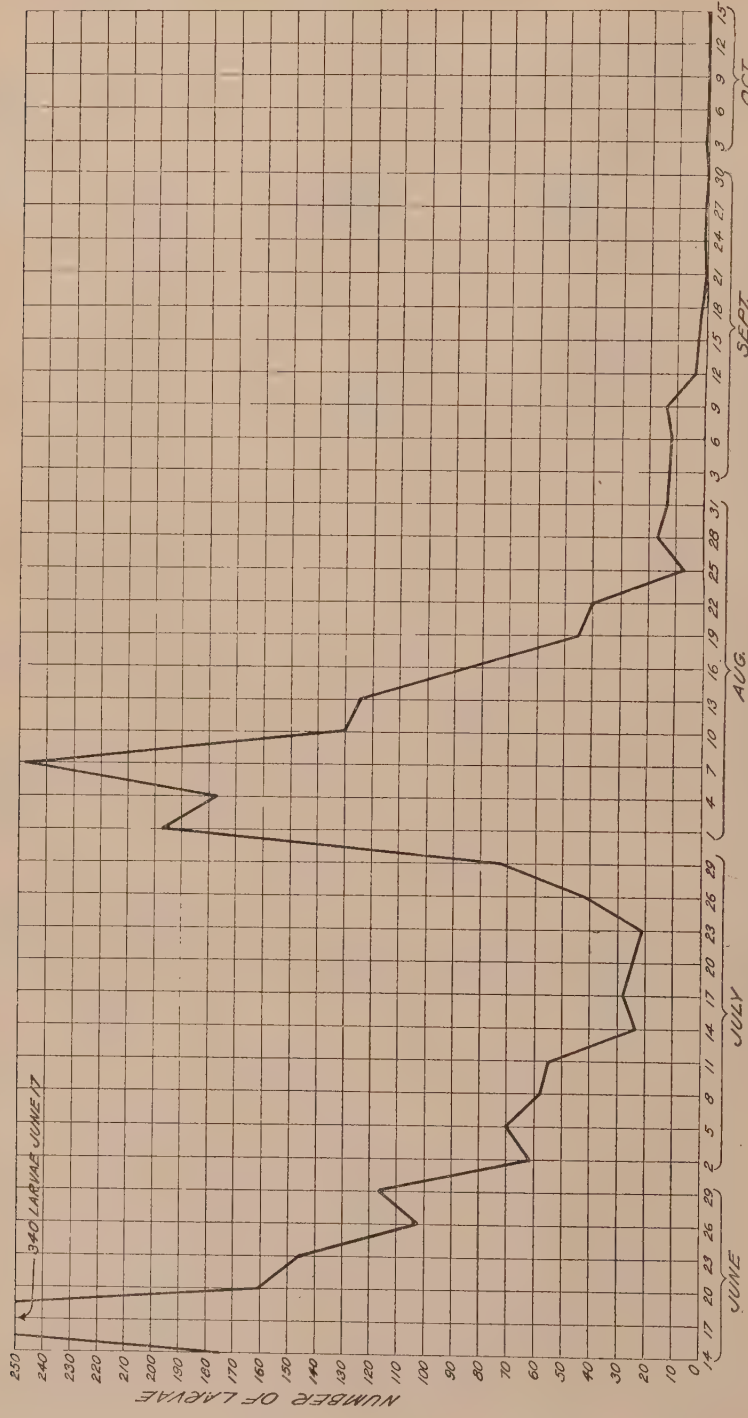

FIG. 6.—Number of larvae of the codling moth collected from banded trees, Dunson orchard, Cornelia, Ga., 1920

TABLE 37.—*Data of 2,637 codling-moth larvae collected from bands in the Dunson orchard, Cornelia, Ga., 1920*

Date of collection, 1920	Collection No.	Larvae collected	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Dead individuals
		Number	*Number*	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
June 14	1	175	134	1	19		76.57	0.57	10.86		12.00
June 17	2	340	220	7	32	1	64.71	2.06	9.41	0.29	23.53
June 20	3	161	113	4	15		70.19	2.48	9.32		18.01
June 23	4	145	89	9	10		61.38	6.21	6.90		25.51
June 26	5	102	74	5	5		72.55	4.90	4.90		17.65
June 29	6	117	78	9	5		66.67	7.69	4.27		21.37
July 2	7	62	38	5			61.29	8.06			30.65
July 5	8	70	38	6	1		54.29	8.57	1.43		35.71
July 8	9	58	32	8	1		55.17	13.79	1.72		29.32
July 11	10	55	27	16	1		49.09	29.09	1.82		20.00
July 14	11	24	13	6			54.17	25.00			20.83
July 17	12	28	7	11	3		25.00	39.29	10.71		25.00
July 20	13	25	8	10			32.00	40.00			28.00
July 23	14	22	5	5	1	1	22.73	22.73	4.54	4.54	45.46
July 26	15	42	14	11	4	1	33.33	26.19	9.52	2.38	28.58
July 29	16	73	12	18	11	4	16.44	24.66	15.07	5.48	38.35
Aug. 1	17	197	17	48	16	29	8.63	24.37	8.12	14.72	44.16
Aug. 4	18	177		64	11	43		36.16	6.22	24.29	33.33
Aug. 7	19	248	4	96	9	44	1.61	38.71	3.63	17.74	38.31
Aug. 10	20	130	1	49	1	26	.77	37.69	.77	20.00	40.77
Aug. 13	21	124		38		21		30.65		16.93	52.42
Aug. 16	22	87		42	3	6		48.28	3.45	6.90	41.37
Aug. 19	23	45		11		5		24.44		11.11	64.45
Aug. 22	24	40		14		3		35.00		7.50	57.50
Aug. 25	25	7		1				14.28			85.72
Aug. 28	26	17		7				41.18			58.82
Aug. 31	27	14		3				21.43			78.57
Sept. 3	28	13		3		2		23.08		15.38	61.54
Sept. 6	29	12		7				58.33			41.67
Sept. 9	30	14		4		2		28.57		14.29	57.14
Sept. 12	31	4		4				100.00			
Sept. 15	32	3		1				33.33			66.67
Sept. 18	33	2		1				50.00			50.00
Sept. 21	34										
Sept. 24	35	1		1				100.00			
Sept. 27	36	1		1				100.00			
Oct. 3	37	1		1				100.00			
Oct. 15	38	1									100.00
Total		2,637	924	527	148	188					
Average							35.04	19.98	5.61	7.13	32.24

TABLE 38.—*Emergence of 922 codling moths from band-record material collected from the Dunson orchard, Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 25	1	July 10	22	July 25	18	Aug. 12	2
June 26	5	July 11	13	July 26	2	Aug. 13	7
June 27	23	July 12	38	July 27	8	Aug. 14	1
June 28	44	July 13	15	July 28	2	Aug. 15	2
June 29	20	July 14	18	July 29	3	Aug. 16	7
June 30	35	July 15	21	July 30	3	Aug. 17	7
July 1	62	July 16	12	July 31	1	Aug. 18	3
July 2	96	July 17	11	Aug. 1	3	Aug. 19	1
July 3	112	July 18	15	Aug. 2	6	Aug. 20	2
July 4	38	July 19	8	Aug. 3	2	Aug. 21	1
July 5	26	July 20	15	Aug. 6	2	Aug. 24	1
July 6	49	July 21	9	Aug. 8	3		
July 7	19	July 22	17	Aug. 9	6	Total	922
July 8	22	July 23	8	Aug. 10	7		
July 9	37	July 24	10	Aug. 11	1		

THE SMITH ORCHARD

The Smith orchard is located 6 miles northeast of Cornelia and the experiments were discontinued somewhat early in the season. However, Table 40 gives the time that the first-brood larvae left the fruit. The results are given in Tables 39 and 40 and Figures 8 and 9.

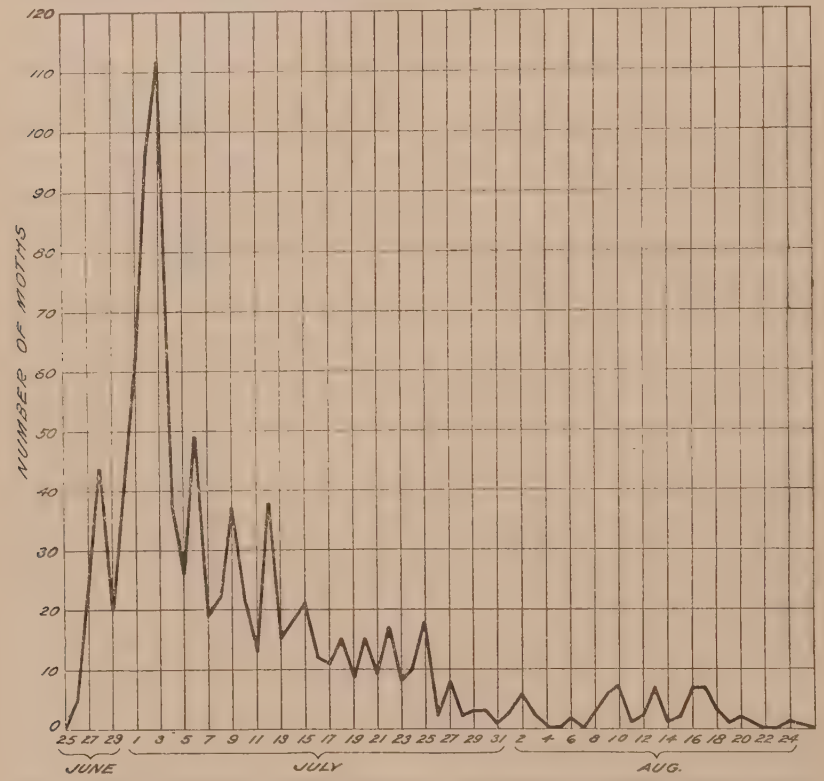

FIG. 7.—Time of emergence of codling moths from hand-collected material, Dunson orchard, Cornelia, Ga., 1920

TABLE 39.—*Data of 637 codling-moth larvae collected from bands in the Smith orchard, Cornelia, Ga., 1920*

Date of collection, 1920	Collection No.	Larvae collected	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Dead individuals
		Number	*Number*	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
June 8	1	1									100.00
June 14	2	45	27		1		60.00		2.22		37.78
June 17	3	115	61	1	13		53.04	0.87	11.30		34.79
June 20	4	69	40	1	11		57.97	1.45	15.94		24.64
June 23	5	71	24	3	6		33.80	4.23	8.45		53.52
June 26	6	40	31	4	4		77.50	10.00	10.00		2.50
June 29	7	67	41	2	2		61.19	2.98	2.99		32.84
July 2	8	44	25	3	4		56.82	6.82	9.09		27.27
July 5	9	51	26	7	4		50.98	13.73	7.84		27.45
July 8	10	50	28	12			56.00	24.00			20.00
July 11	11	40	17	6	1		42.50	15.00	2.50		40.00
July 14	12	21	11	6		1	52.38	28.57		4.76	14.29
July 17	13	11	1	5			9.09	45.45			45.46
July 29	14	12	3	3			25.00	25.00			50.00
Total		637	335	53	46	1					
Average							52.59	8.32	7.22	0.16	31.71

TABLE 40.—*Emergence of 351 codling moths from band-record material collected from the Smith orchard, Cornelia, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 24	1	July 6	1	July 16	6	July 26	3
June 26	2	July 7	2	July 17	5	July 27	2
June 27	4	July 8	15	July 18	13	July 28	5
June 28	15	July 9	15	July 19	8	July 29	3
June 30	14	July 10	9	July 20	18	July 30	1
July 1	23	July 11	7	July 21	5	Aug. 2	1
July 2	24	July 12	24	July 22	4	Aug. 9	1
July 3	20	July 13	12	July 23	1	Aug. 12	1
July 4	16	July 14	12	July 24	10		
July 5	29	July 15	14	July 25	5	Total	351

FIG. 8.—Number of larvae of the codling moth collected from banded trees, Smith orchard, Cornelia, Ga., 1920

HOUSE NO. 2 ORCHARD

The House No. 2 orchard is located one-fourth mile from View or 8 miles southwest of Cornelia. The trees used were 16 in number and of a winter variety. Tables 41 and 42 and Figures 10 and 11 give the results of this experiment.

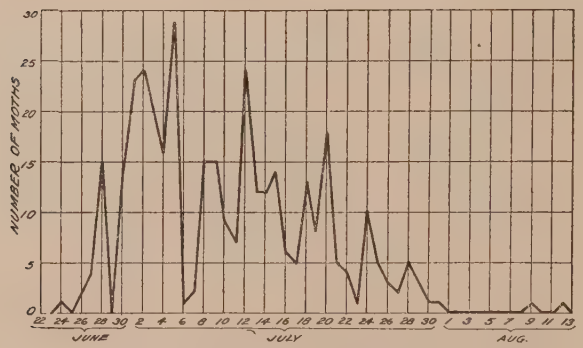

FIG. 9.—Time of emergence of codling moths from band-collected material, Smith orchard, Cornelia, Ga., 1920

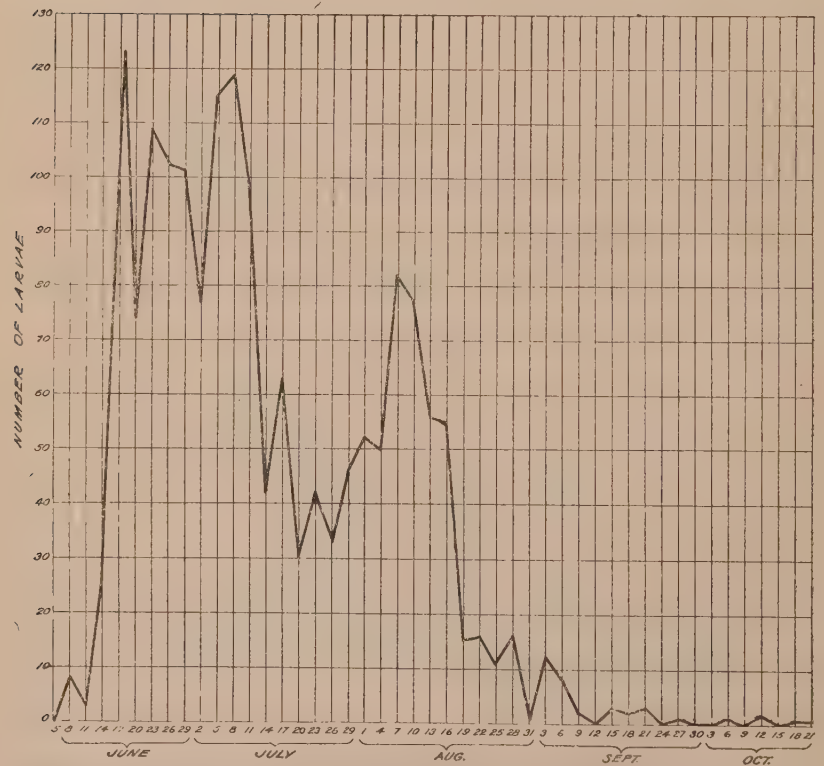

FIG. 10.—Number of larvae of the codling moth collected from banded trees, House No. 2 orchard View, Ga., 1920

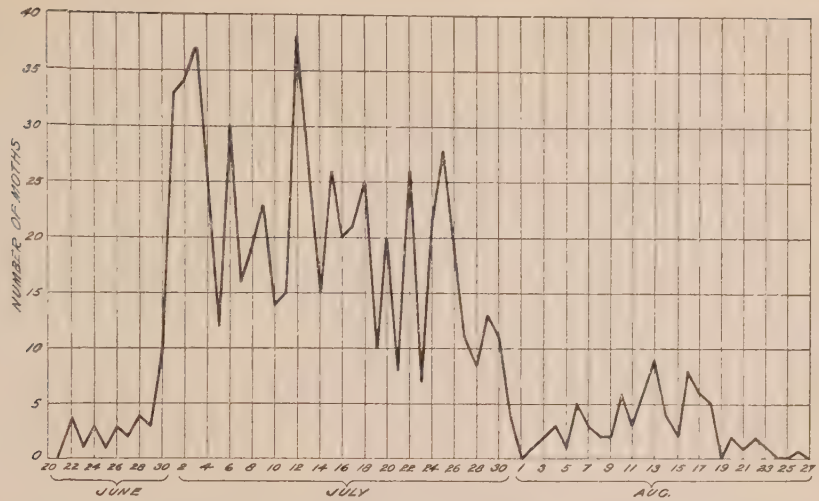

FIG. 11.—Time of emergence of codling moths from band-collected material, House No. 2 orchard, View, Ga., 1920

TABLE 41.—*Data of 1,678 codling-moth larvae collected from bands in the House No. 2 orchard, View, Ga., 1920*

Date of collection, 1920	Collection No.	Larvae collected	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Dead individuals
		Number	*Number*	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
June 8	1	8	5		1		62.50		12.50		25.00
June 11	2	3	3				100.00				
June 14	3	25	16		3		64.00		12.00		24.00
June 17	4	123	79	2	11		64.23	1.63	8.94		25.20
June 20	5	74	64		3		86.49		4.05		9.46
June 23	6	109	62	5	6		56.88	4.59	5.50		33.03
June 26	7	102	55	6	3		53.92	5.88	2.94		37.26
June 29	8	101	84	9	4		83.17	8.91	3.96		3.96
July 2	9	77	55	4	3		71.43	5.19	3.90		19.48
July 5	10	115	73	21	7		63.48	18.26	6.09		12.17
July 8	11	119	62	43	5		52.10	36.13	4.20		7.57
July 11	12	99	43	35	1		43.44	35.35	1.01		20.20
July 14	13	42	27	7			64.29	16.67			19.04
July 17	14	63	20				31.75				68.25
July 20	15	30	4	9	1		13.34	30.00	3.33		53.33
July 23	16	42	10	13			23.81	30.95			45.24
July 26	17	33	13	12			39.39	36.37			24.24
July 29	18	46	19	19	1	1	41.30	41.30	2.17	2.17	13.06
Aug. 1	19	52	17	19			32.69	36.54			30.77
Aug. 4	20	50	5	21	1	6	10.00	42.00	2.00	12.00	34.00
Aug. 7	21	82	5	45	3	5	6.10	54.88	3.65	6.10	29.27
Aug. 10	22	77		44	1	2		57.14	1.30	2.60	38.96
Aug. 13	23	56		28		1		50.00		1.79	48.21
Aug. 16	24	55		18		1		32.73		1.82	65.45
Aug. 19	25	15		9		2		60.00		13.33	26.67
Aug. 22	26	16		9		1		56.25		6.25	37.50
Aug. 25	27	11		4				36.36			63.64
Aug. 28	28	16		8				50.00			50.00
Aug. 31	29	1			1			100.00			
Sept. 3	30	12		7		1		58.33		8.33	33.34
Sept. 6	31	8		4		1		50.00		12.50	37.50
Sept. 9	32	2									100.00
Sept. 12											
Sept. 15	33	3		3				100.00			
Sept. 18	34	2									100.00
Sept. 21	35	3		1				33.33			66.67
Sept. 24	36										
Sept. 27	37	1									100.00
Oct. 6	38	1									100.00
Oct. 12	39	2									100.00
Oct. 18	40	1									100.00
Oct. 21	41	1									100.00
Total		1,678	721	405	55	21					
Average							42.97	24.14	3.28	1.25	28.36

TABLE 42.—*Emergence of 721 codling moths from band-record material collected from the House No. 2 orchard, View, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 22	4	July 8	19	July 24	21	Aug. 10	6
June 23	1	July 9	23	July 25	28	Aug. 11	3
June 24	3	July 10	14	July 26	19	Aug. 12	6
June 25	1	July 11	15	July 27	11	Aug. 13	9
June 26	3	July 12	38	July 28	8	Aug. 14	4
June 27	2	July 13	26	July 29	13	Aug. 15	2
June 28	4	July 14	15	July 30	11	Aug. 16	8
June 29	3	July 15	26	July 31	4	Aug. 17	6
June 30	10	July 16	20	Aug. 2	1	Aug. 18	5
July 1	33	July 17	21	Aug. 3	2	Aug. 20	2
July 2	34	July 18	25	Aug. 4	3	Aug. 21	1
July 3	37	July 19	10	Aug. 5	1	Aug. 22	2
July 4	25	July 20	20	Aug. 6	5	Aug. 23	1
July 5	12	July 21	8	Aug. 7	3	Aug. 26	1
July 6	30	July 22	26	Aug. 8	2		
July 7	16	July 23	7	Aug. 9	2	Total	721

HOUSE NO. 1 ORCHARD

The House No. 1 orchard is located 6 miles northwest of Cornelia and consists of nine trees of a summer variety. The band collections were discontinued after August 28. The important periods, as shown in Table 44, check up very well with other band-record experiments. The results are given in Tables 43 and 44 and Figures 12 and 13.

TABLE 43.—*Data of 516 codling-moth larvae collected from bands in the House No. 1 orchard, View, Ga., 1920*

Date of collection, 1920	Collection No.	Larvae collected	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Moths emerging, 1920	Moths emerging, 1921	Parasites emerging, 1920	Parasites emerging, 1921	Dead individuals
		Number	*Number*	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
June 8	1	2	1	1			50.00	50.00			
June 14	2	9									100.00
June 17	3	53	37		6		69.81		11.32		18.87
June 20	4	32	21	2	3		65.63	6.25	9.37		18.75
June 23	5	25	15		1		60.00		4.00		36.00
June 26	6	27	19		1		70.37		3.70		25.93
June 29	7	28	16	4	2		57.14	14.29	7.14		21.43
July 2	8	16	9	5	1	1	56.25	31.25	6.25	6.25	
July 5	9	32	18	8			56.25	25.00			18.75
July 8	10	17	8	1			47.06	5.88			47.06
July 11	11	23	17	3			73.91	13.04			13.05
July 14	12	7	3	3			42.86	42.86			14.28
July 17	13	6	3	1			50.00	16.67			33.33
July 20	14	8	1	3	1		12.50	37.50	12.50		37.50
July 23	15	8		4				50.00			50.00
July 26	16	8	3	1			37.50	12.50			50.00
July 29	17	12		6				50.00			50.00
Aug. 1	18	37	5	10	2	6	13.51	27.03	5.40	16.22	37.84
Aug. 4	19	50	1	13	2	3	2.00	26.00	4.00	6.00	62.00
Aug. 7	20	31	1	9			3.22	29.03			67.75
Aug. 10	21	32		14		3		43.75		9.37	46.88
Aug. 13	22	30									100.00
Aug. 16	23	10	1	4			10.00	40.00			50.00
Aug. 19	24	7		2				28.57			71.43
Aug. 22	25	5									100.00
Aug. 25	26	1		1				100.00			
Total		516	179	95	19	13					
Average							34.69	18.41	3.68	2.52	40.70

TABLE 44.—*Emergence of 180 codling moths from band-record material collected from the House No. 1 orchard, View, Ga., 1920*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 21	1	July 10	4	July 22	5	Aug. 11	1
June 30	6	July 11	4	July 23	1	Aug. 15	1
July 1	16	July 12	9	July 24	3	Aug. 17	1
July 2	12	July 13	1	July 25	9	Aug. 18	3
July 3	14	July 14	3	July 26	2	Aug. 22	1
July 4	3	July 15	5	July 28	3	Aug. 23	1
July 5	3	July 16	4	July 30	3	Sept. 2	1
July 6	8	July 17	4	July 31	1		
July 7	5	July 18	9	Aug. 1	3	Total	180
July 8	6	July 19	5	Aug. 2	1		
July 9	12	July 20	4	Aug. 9	2		

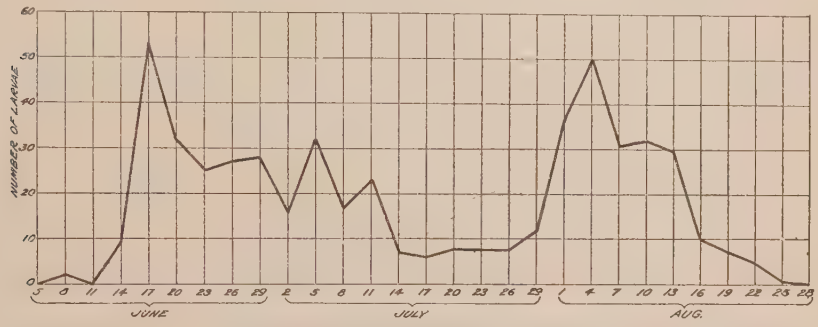

FIG. 12.—Number of larvae of the codling moth collected from banded trees, House No. 1 orchard, View, Ga., 1920

SUMMARY OF BAND RECORDS

Under field or normal conditions there is an overlapping of broods, that is, the last larvae of the first brood will be leaving the fruit at

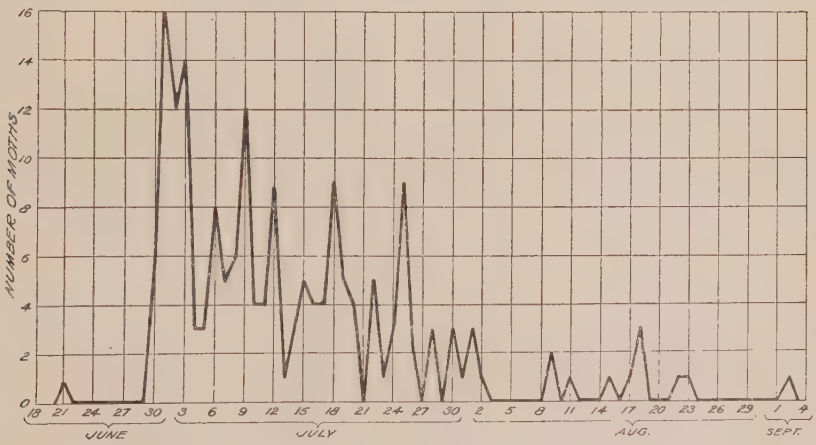

FIG. 13.—Time of emergence of codling moths from band-collected material, House No. 1 orchard, View, Ga., 1920

the same time as the first larvae of the second brood begin to leave. This is also true of the emergence of the moths. It is possible to have late spring-brood moths emerging at the same time the first of the first-brood moths emerge. Therefore, in the field it is impossible to know at all times to which brood the individuals belong. With

insects reared under insectary conditions it is possible to keep the individuals of the different broods separated. The most important data from band-record experiments are found in Tables 45 and 46. These tables give the approximate dates of the appearance of several stages of the codling moth in the field.

TABLE 45.—*Summary of the time of leaving the fruit of codling-moth larvae collected from banded trees, Cornelia, Ga., 1920*

Name of orchard	Approximate date of appearance of first-brood larvae			Approximate date of appearance of second-brood larvae		
	First	Maximum	Last	First	Maximum	Last
Dunson	----------	June 17	July 20	July 17	Aug. 2	Aug. 28
Cornelia	June 8	---do----	July 23	July 14	Aug. 10	Sept. 3
Smith	---do----	---do----	(1)	(1)	(1)	(1)
House No. 1	---do----	---do----	July 26	July 17	Aug. 7	Sept. 3
House No. 2	---do----	---do----	July 23	July 14	Aug. 4	Aug. 31

[1] Discontinued.

TABLE 46.—*Summary of the emergence of codling moths from band-record material, Cornelia, Ga., 1920*

Name of orchard	Approximate date of appearance of first-brood moths			Approximate date of appearance of second-brood moths		
	First	Maximum	Last	First	Maximum	Last
Dunson	June 25	July 3	Aug. 7	Aug. 4	Aug. 17	Aug. 25
Cornelia	June 21	July 2	Aug. 8	Aug. 2	---do----	Aug. 30
Smith	June 24	July 5	Aug. 4	(1)	(1)	(1)
House No. 1	June 21	July 2	Aug. 3	Aug. 2	Aug. 18	Aug. 24
House No. 2	June 22	July 3	---do----	July 28	Aug. 13	Aug. 27

[1] Discontinued.

SEASONAL-HISTORY STUDIES OF 1921

The life-history studies of the codling moth which were commenced in 1920 were continued during the season of 1921. The results do not in general differ greatly from those obtained the preceding year. In the presentation of the observations made during the second year, the same plan was followed as for the first year, and the methods and tabulation previously described apply equally to the season of 1921.

The spring of 1921 developed about one month earlier than that of 1920. In 1920 the apple trees were in full bloom on April 25; in 1921 the trees were in full bloom on March 25. This resulted in the various stages of the insect being much earlier in 1921 than in 1920, as was noticeable throughout ths season.

SOURCE OF WINTERING MATERIAL

The rearing material in the spring of 1921 consisted of wintering larvae, which were collected from band records, and also of material reared the preceding season at the insectary which in a normal way had entered hibernation. The wintering cocoons were made between pieces of corrugated paper and the larvae used for pupation records were placed in regular pupation racks and kept during the winter in an outdoor shelter.

Owing to the mild weather, the percentage of larvae killed by cold during the winter proved to be small. During the winter of 1920–21 the coldest temperature registered was 22° F. Many of the larvae which failed to live over the winter, as shown in the band-record tables, were injured in the course of transportation from field to laboratory and by being disturbed while under observation from day to day.

Temperature, precipitation, and other climatological data, compiled from the records of the Weather Bureau station at Cornelia, are given in Tables 47 and 48.

TABLE 47.—*Climatological data for Cornelia, Ga., 1921*

Month	Temperature							Precipitation			Number of days—				Prevailing direction of wind
	Mean	Extremes				Greatest daily range		Total	Greatest in 24 hours	Snowfall (unmelted)	With precipitation (0.01 inch or more)	Clear	Partly cloudy	Cloudy	
		Highest	Day of month	Lowest	Day of month										
	° F.	° F.		° F.		° F.		*Inches*	*Inches*	*Inches*					
January	44.2	67	22	22	19	29		4.57	1.76	2.2	10	13	7	11	W.
February	46.7	72	14	24	24	30		10.73	3.57	3.2	12	10	5	13	W.
March	59.2	83	18	30	4	30		1.47	0.87	0.0	8	10	5	16	W.
April	59.5	84	25	31	11	33		2.90	1.60	0.0	8	19	6	5	E.
May	65.8	89	24	43	2	34		6.65	1.75	0.0	10	10	8	13	E.
June	76.7	98	14	60	8	30		1.41	0.48	0.0	4	11	10	9	W.
July	77.4	94	11	62	22	27		7.95	2.05	0.0	14	8	12	11	E.
August	74.7	94	1	59	27	26		2.75	0.50	0.0	13	10	10	11	E.
September	76.4	93	7	60	22	27		6.22	1.20	0.0	14	15	11	4	W.
October	57.9	78	11	35	5	31		3.00	1.08	0.0	5	22	6	3	W.
November	55.2	72	5	27	13	34		5.51	1.29	0.0	12	11	4	15	E.
December	46.4	65	3	25	30	29		3.65	1.54	0.0	6	18	4	9	W.

TABLE 48.—*Daily temperatures at Cornelia, Ga., March to November, 1921*

Day of month	March		April		May		June		July		August		September		October		November	
	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum
	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.	° F.
1	45	17	65	45	80	56	83	62	84	71	87	67	86	66	58	43	69	44
2	50	28	71	51	83	49	80	62	86	69	85	69	83	63	64	37	62	54
3	54	32	62	41	65	53	86	63	88	69	77	65	73	61	68	42	64	39
4	50	42	66	44	79	50	79	66	90	70	77	64	63	58	72	46	63	40
5	41	27	58	37	73	56	80	65	90	68	75	60	75	58	79	51	67	45
6	40	19	59	26	69	56	78	59	85	61	81	62	80	62	73	54	66	44
7	27	20	56	45	76	50	78	59	85	61	85	67	80	60	70	50	70	41
8	41	11	66	40	76	57	84	59	88	68	78	66	73	62	69	40	75	42
9	54	22	52	45	80	47	87	61	88	60	76	67	81	63	75	44	73	51
10	61	33	62	38	81	49	91	62	84	61	81	69	80	65	81	52	75	56
11	60	45	70	38	84	51	93	64	81	63	79	68	86	67	79	52	67	56
12	62	53	70	51	86	58	94	68	85	64	80	67	87	68	79	51	61	39
13	57	34	60	42	76	61	94	70	87	63	79	68	83	65	79	50	42	32
14	55	29	60	29	74	53	93	72	89	67	79	68	85	67	79	50	45	22
15	66	38	71	36	67	48	94	69	87	66	84	68	81	63	76	51	42	34
16	70	48	68	48	69	50	92	70	87	65	83	63	86	68	79	50	44	34
17	63	55	84	53	63	51	91	72	82	64	84	66	78	65	80	57	43	28
18	72	46	70	57	60	54	90	65	77	68	82	66	77	58	75	60	53	30
19	63	56	81	55	74	53	85	68	83	68	82	68	83	58	73	37	60	35
20	58	40	66	59	79	55	75	61	85	68	83	67	79	60	77	53	68	38
21	59	32	78	61	76	61	77	58	84	71	85	65	78	61	76	54	64	42
22	60	34	84	53	86	59	80	61	86	68	83	68	75	60	76	53	57	41
23	63	35	77	64	87	64	80	61	88	66	81	65	84	62	79	54	48	38
24	70	42	76	55	85	53	81	63	91	69	79	66	79	68	73	62	58	34
25	72	54	60	49	72	60	85	62	90	72	82	65	80	68	69	56	54	36
26	73	52	60	50	71	56	82	61	83	68	80	65	83	63	73	62	51	27
27	75	49	74	50	79	56	83	66	80	63	74	65	87	65	72	64	44	39
28	69	50	61	44	86	55	84	63	82	63	80	63	85	65	66	43	58	42
29	70	51	75	43	85	59	91	65	86	64	82	63	76	65	54	35	51	41
30	65	34	79	53	83	64	88	67	89	65	85	67	67	47	59	33	43	39
31	53	41	----	----	80	63	----	----	89	64	87	69	----	----	62	39	----	----
Mean	58.6	37.7	68.0	46.7	76.9	55.1	85.3	64.1	85.8	66.0	81.1	66.0	79.8	62.7	72.4	49.2	57.9	39.4

PUPAE OF THE SPRING BROOD

Time of pupation.—The daily observations of the time of pupation of the wintering larvae are tabulated in Table [illegible]. This table shows that [illegible] larvae were under observation during the period from March [illegible] to May [illegible], the period covering [illegible] days. Owing to the failure of the writer to reach the field in time to observe the first pupation, which occurred a month earlier than in the preceding season,

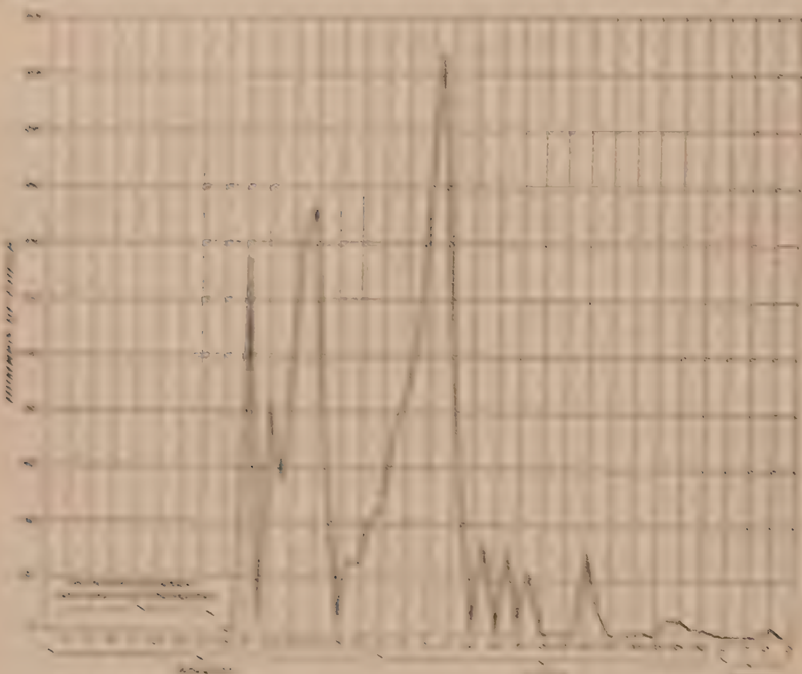

FIG. [illegible].—[illegible] spring brood [illegible] codling moth, [illegible], 192[illegible]

the earliest pupation is not recorded. Figure 14 gives the approximate date of the first pupation as March 4, this date being determined from the first emergence of the moth.

TABLE [illegible].—*Time of pupation of [illegible] wintering larvae of the codling moth, [illegible], [illegible], 192[illegible]*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	Total	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

Length of the pupal stage.— The results of observations are given in Table 50. The average length of the pupal stage was 29.96 days, the maximum 63 and the minimum 10. The total number of individuals observed was 1,604.

TABLE 50.—*Length of the pupal stage of 1,604 pupae of the spring brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days																			
		10	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Mar. 20	4																	1			
Mar. 21	126							1		1	1			1		5	6	1			4
Mar. 22	4															1					
Mar. 23	72				1										1	2			1	1	
Mar. 24	53						1						3					1			1
Mar. 25	83				1													1		1	4
Mar. 26	136	1									1									1	58
Mar. 27	145																	1		8	63
Mar. 28	52														1			2	2	4	18
Mar. 29	1																	1			
Mar. 30	21		1													1	1	1	8	8	
Mar. 31	24														1	1		6	8	5	
Apr. 1	40												1		1	1	7	17	10	2	1
Apr. 2	38															4	15	11		6	1
Apr. 3	71															7	24	3	28	4	
Apr. 4	75						1								3	8	3	32	3		
Apr. 5	94								1						3	4	13	8			12
Apr. 6	149					1					3	2		1		3	1			10	69
Apr. 7	181			1				1	1		2		1	1		1				5	49
Apr. 8	94								1		1	1								5	15
Apr. 9	30																			2	7
Apr. 11	30						1										1	2	2	15	7
Apr. 13	25														1	2		4	14	1	3
Apr. 14	3													1						2	
Apr. 15	16																2	2	8	3	1
Apr. 20	19								1						5	9	3	1			
Apr. 21	5							1		1			1				1	1			
Apr. 25	1																				1
Apr. 27	3											1		1		1					
Apr. 28	4							1				1			2						
Apr. 29	2									1					1						
May 1	1														1						
May 6	1			1																	
Total	1,604	1	1	2	2	1	3	4	4	3	8	5	6	6	21	48	77	96	84	83	305

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days																			
		31	32	33	34	35	36	37	38	39	40	41	42	43	44	47	48	50	54	58	63
Mar. 20	4		1		2																
Mar. 21	126	6	1	27	57	10		1		2							1				1
Mar. 22	4		1	1	1																
Mar. 23	72	4	34	26	1											1					
Mar. 24	53	23	21	2			1														
Mar. 25	83	65	7			1							2		1						
Mar. 26	136	70	2	1								2									
Mar. 27	145	47	23	2							1										
Mar. 28	52	17	7		1																
Mar. 30	21	1																			
Mar. 31	24	3																			
Apr. 2	38																			1	
Apr. 3	71			4															1		
Apr. 4	75	7	14	2		1			1												
Apr. 5	94	37	12	1		1	1											1			
Apr. 6	149	52	13			1	1							1							
Apr. 7	181	97	19	3																	
Apr. 8	94	56	14	1																	
Apr. 9	30	16	4	1																	
Apr. 11	30	1									1										
Apr. 17	1	1																			
Total	1,604	503	173	71	62	14	3	1	1	2	2	2	2	1	1	1	1	1	1	1	1

MOTHS OF THE SPRING BROOD

Time of emergence.—Moth emergence commenced on March 23 and continued until May 30. The maximum emergence occurred on

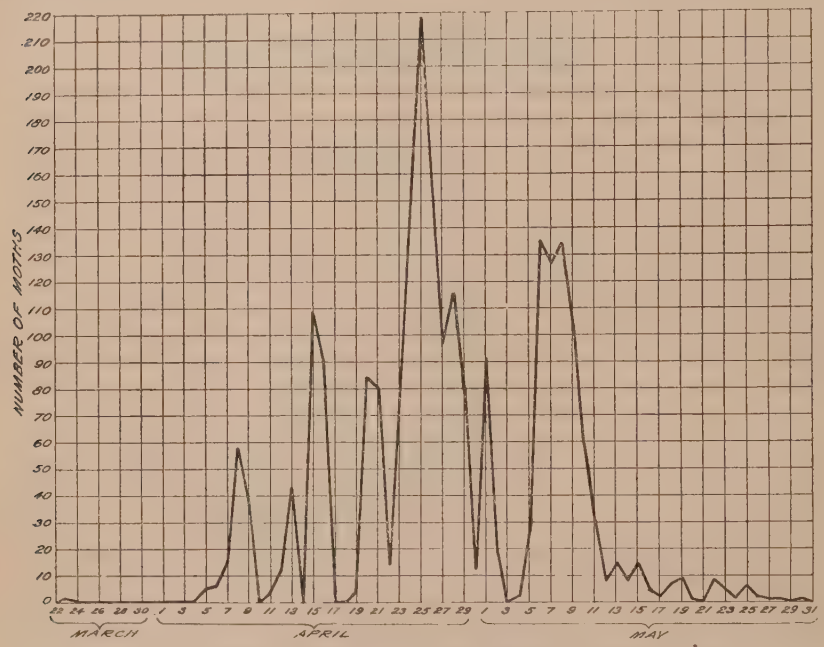

FIG. 15.—Emergence of codling moths of the spring brood, Cornelia, Ga., 1921

April 25, on which date 218 moths appeared. The daily emergence of 2,267 moths is shown in Figure 15 and Table 51.

TABLE 51.—*Time of emergence of 2,267 codling moths of the spring brood, Cornelia, Ga., 1921*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
Mar. 23	1	Apr. 21	80	May 5	31	May 18	7
Apr. 5	5	Apr. 22	14	May 6	135	May 19	9
Apr. 6	6	Apr. 23	57	May 7	126	May 20	1
Apr. 7	16	Apr. 24	146	May 8	134	May 22	9
Apr. 8	58	Apr. 25	218	May 9	104	May 23	5
Apr. 9	37	Apr. 26	151	May 10	59	May 24	2
Apr. 11	3	Apr. 27	97	May 11	31	May 25	6
Apr. 12	12	Apr. 28	115	May 12	8	May 26	2
Apr. 13	43	Apr. 29	79	May 13	15	May 27	1
Apr. 15	109	Apr. 30	13	May 14	8	May 28	1
Apr. 16	90	May 1	92	May 15	15	May 30	1
Apr. 19	4	May 2	18	May 16	5		
Apr. 20	84	May 4	2	May 17	2	Total	2,267

Time of oviposition.—The data obtained from the oviposition studies of 493 female moths, confined in 52 cages with 486 males, are presented in Table 52. On an average the moths commenced to oviposit 3 days after the date of emergence, and most of the eggs were laid within a week of emergence. The average period of deposi-

tion was 20.87 days, maximum 42, minimum 2. The average time from the date of emergence of the moth to the end of the deposition period was 23.82 days, maximum 45, minimum 10.

TABLE 52.—*Oviposition by 493 codling moths of the spring brood in rearing cages, Cornelia, Ga., 1921*

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
1	1		1	Mar. 23	Apr. 15		63			
	2		2	Apr. 5						
	10	5	5	Apr. 6						
	16		16	Apr. 7						
2	27	14	13	Apr. 8	Apr. 13	May 8	873	5	26	30
3	23	11	12	Apr. 9	Apr. 15	May 14	847	6	30	35
4	13	9	4	Apr. 12	Apr. 16	May 27	209	4	42	45
5	32	16	16	Apr. 13	do	May 10	590	3	25	27
6	28	13	15	Apr. 16	Apr. 23	May 17	724	7	25	31
7	30	15	15	do	Apr. 21	May 13	728	5	23	27
8	6	3	3	Apr. 19	Apr. 23	May 12	204	4	20	23
9	29	15	14	Apr. 20	Apr. 24	May 10	470	4	17	20
10	29	14	15	Apr. 21	do	May 16	1,367	3	23	25
11	26	14	12	do	Apr. 25	May 18	1,060	4	24	27
12	12	6	6	Apr. 22	Apr. 27	May 13	222	5	17	21
13	30	15	15	Apr. 23	Apr. 25	May 15	850	2	21	22
14	25	13	12	Apr. 24	Apr. 26	May 22	934	2	27	28
15	28	13	15	Apr. 25	Apr. 27	May 16	588	2	20	21
16	30	15	15	Apr. 26	Apr. 28	May 21	1,352	2	24	25
17	30	14	16	do	do	May 19	676	2	22	23
18	30	15	15	Apr. 27	May 1	May 22	865	4	22	25
19	28	14	14	do	do	May 19	784	4	19	22
20	30	15	15	Apr. 28	May 6	do	560	8	14	21
21	30	17	13	Apr. 29	do	May 26	1,498	7	21	27
22	28	13	15	do	do	May 28	1,050	7	23	29
23	12	10	2	Apr. 30	May 9	May 17	19	9	9	17
24	26	12	14	May 1	May 8	May 24	1,173	7	17	23
25	18	12	6	May 2	do	May 27	657	6	20	25
26	27	17	10	May 5	May 9	May 26	803	4	18	21
27	30	15	15	May 6	do	May 31	497	3	23	25
28	28	13	15	May 7	May 11	May 29	969	4	19	22
29	30	15	15	May 8	May 10	June 1	887	2	23	24
30	27	12	15	May 9	May 11	June 5	1,028	2	26	27
31	27	12	15	May 10	May 12	June 4	1,464	2	24	25
32	18	9	9	May 11	May 13	May 25	495	2	13	24
33	6	3	3	May 12	May 14	May 31	315	2	18	19
34	13	6	7	May 13	May 16	June 1	490	3	17	19
35	4	2	2	May 14	May 17	June 4	145	3	19	21
36	15	7	8	May 15	do	June 2	451	2	17	18
37	14	7	7	May 16	May 18	June 6	485	2	20	21
38	8	4	4	May 17	May 21	May 29	262	4	9	12
39	14	7	7	May 18	do	June 4	785	3	15	17
40	18	9	9	May 19	May 22	June 8	791	3	18	20
41	3		3	do	May 24	June 4	176	5	12	16
42	3	3		May 20						
43	12	6	6	May 21	May 23	June 6	506	2	15	16
44	15	7	8	May 22	do	June 10	888	1	19	19
45	12	6	6	May 23	May 25	June 2	193	2	9	10
46	10	5	5	May 24	May 26	June 10	468	2	16	17
47	6	3	3	May 25	May 27	do	111	2	15	16
48	2	1	1	May 26	May 28	June 8	205	2	12	13
49	3	2	1	May 27	May 29	do	143	2	11	12
50	2	1	1	May 28	May 30	June 12	126	2	14	15
51	1		1	May 29	do	June 10	27	1	12	12
52	2	1	1	May 30	June 9	do	2	10	2	11
Total	979	486	493				31,075			
Average								3.76	20.87	23.82

Number of eggs per female moth.—The average number of eggs deposited per female moth was 63.03. (Table 52.)

Length of life of moths.—A summary of observations on the life of 951 moths is given in Table 53. The average length of life of 482 male

moths was 17.35 days, maximum 40, minimum 1; the average length of life of 469 female moths was 17.54 days, maximum 36, minimum 2.

TABLE 53.—*Length of life of 482 male and 469 female codling moths of the spring brood in captivity, Cornelia, Ga., 1921*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*			*Days*		
1	2	0	14	25	22	27	11	9
2	0	1	15	26	31	28	11	8
3	5	2	16	20	38	29	8	6
4	4	6	17	22	32	30	11	3
5	8	4	18	22	33	31	5	2
6	18	3	19	30	37	32	7	2
7	9	8	20	21	23	33	3	3
8	17	8	21	25	22	34	2	1
9	13	7	22	20	19	35	0	1
10	16	14	23	14	22	36	3	1
11	25	28	24	9	13	40	2	0
12	18	20	25	11	13			
13	23	14	26	16	13	Total	482	469

THE FIRST GENERATION

EGGS OF THE FIRST BROOD

Time of deposition.—Figure 16 and Table 54 show that the earliest deposition by moths of the spring brood was made April 13, and the last deposition June 10. Oviposition occurred over a period of 59 days.

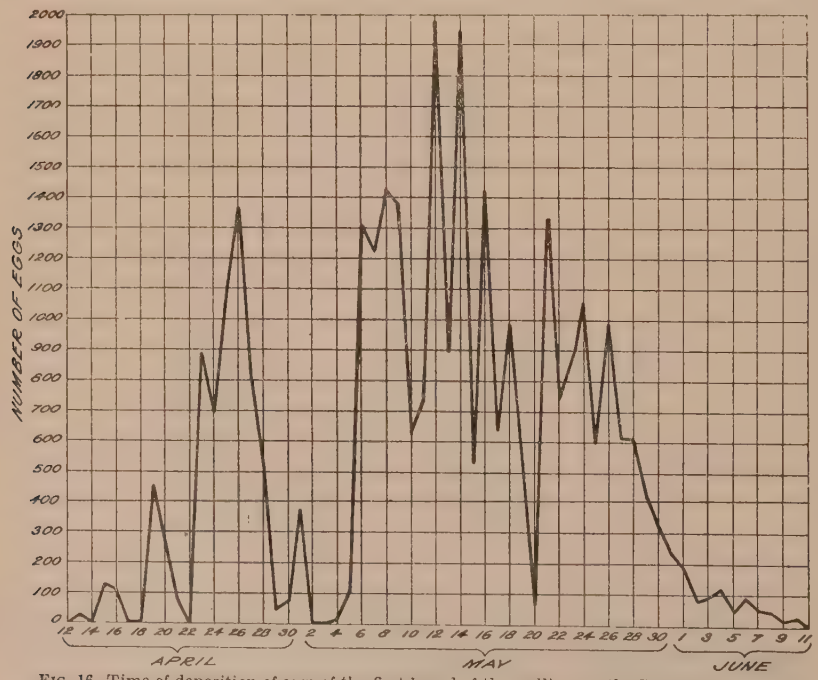

FIG. 16.—Time of deposition of eggs of the first brood of the codling moth, Cornelia, Ga., 1921

TABLE 54.—*Time of deposition, length of incubation, and time of hatching of 31,222 eggs of the first brood of the codling moth, Cornelia, Ga., 1921*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
1	21	Apr. 13	Apr. 16	Apr. 22	Apr. 24	21	3	9	11	
2	123	Apr. 15	Apr. 18	Apr. 24	Apr. 26	93	3	9	11	
3					Apr. 27	30	3	9	12	
4	111	Apr. 16	Apr. 20	Apr. 26	Apr. 28	20	4	10	12	
5					Apr. 29	91	4	10	13	
6	450	Apr. 19	Apr. 23	Apr. 27	do	356	4	8	10	
7					Apr. 30	85	4	8	11	
8					May 1	9	4	8	12	
9	245	Apr. 20	Apr. 23	Apr. 29	Apr. 30	181	3	9	10	
10					May 1	64	3	9	11	
11	74	Apr. 21	Apr. 24	Apr. 30	do	5	3	9	10	
12					May 2	19	3	9	11	
13					May 3	33	3	9	12	
14					May 4	6	3	9	13	
15					May 5	7	3	9	14	
16					May 6	2	3	9	15	2
17	883	Apr. 23	Apr. 26	May 4	do	751	3	11	13	
18					May 7	132	3	11	14	
19	683	Apr. 24	Apr. 27	May 7	May 8	635	3	13	14	14
20					May 9	34	3	13	15	
21	1,101	Apr. 25	Apr. 28	May 8	May 10	1,024	3	13	15	22
22					May 11	55	3	13	16	
23	1,377	Apr. 26	Apr. 29	May 9	do	868	3	13	15	
24					May 12	468	3	13	16	
25					May 13	41	3	13	17	
26	818	Apr. 27	Apr. 30	May 10	do	663	3	13	16	
27					May 14	155	3	13	17	
28	526	Apr. 28	May 2	May 12	May 13	11	4	14	15	
29					May 14	499	4	14	16	
30					May 15	16	4	14	17	
31	50	Apr. 29	May 4	May 13	do	45	5	14	16	
32					May 16	5	5	14	17	
33	74	Apr. 30	May 6	May 13	May 15	30	6	13	15	
34					May 16	23	6	13	16	
35					May 17	21	6	13	17	
36	375	May 1	May 5	May 13	May 15	63	4	12	14	
37					May 16	282	4	12	15	
38					May 17	30	4	12	16	
39	16	May 4	May 8	May 14	May 15	8	4	10	11	
40					May 16	6	4	10	12	
41					May 17	2	4	10	13	
42	112	May 5	May 9	May 14	May 16	49	4	9	11	
43					May 17	63	4	9	12	
44	1,305	May 6	May 10	May 15	do	1,174	4	9	11	
45					May 18	131	4	9	12	
46	1,222	May 7	May 11	May 16	do	1,112	4	9	11	24
47					May 19	86	4	9	12	
48	1,425	May 8	May 12	May 17	do	1,382	4	9	11	
49					May 20	43	4	9	12	
50	1,378	May 9	May 13	May 18	do	1,295	4	9	11	
51					May 21	83	4	9	12	
52	637	May 10	May 14	May 19	do	599	4	9	11	6
53					May 22	32	4	9	12	
54	731	May 11	May 15	May 20	May 21	292	4	9	10	
55					May 22	439	4	9	11	
46	1,975	May 12	May 16	May 21	do	1,876	4	9	10	
57					May 23	99	4	9	11	
58	893	May 13	May 17	May 21	do	893	4	8	10	
59	1,948	May 14	May 18	May 22	do	1,714	4	8	9	
60					May 24	234	4	8	10	
61	526	May 15	May 19	May 23	do	526	4	8	9	
62	1,423	May 16	May 20	do	do	128	4	7	8	
63					May 25	1,267	4	7	9	
64					May 26	28	4	7	10	
65	631	May 17	May 21	May 24	May 25	618	4	7	8	
66					May 26	13	4	7	9	
67	984	May 18	May 22	May 24	May 25	39	4	6	7	
68					May 26	945	4	6	8	
69	523	May 19	May 23	May 25	do	460	4	6	7	
70					May 27	63	4	6	8	

TABLE 54.—*Time of deposition, length of incubation, and time of hatching of 31,222 eggs of the first brood of the codling moth, Cornelia, Ga., 1921*—Con.

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
71	62	May 20	May 24	May 26	May 27	62	4	6	7	
72	1,330	May 21	May 25	do	do	346	4	5	6	
73					May 28	984	4	5	7	
74	739	May 22	May 25	May 27	do	739	3	5	6	
75	862	May 23	do	May 28	May 29	862	2	5	6	
76	1,055	May 24	May 27	May 29	May 30	1,055	3	5	6	
77	592	May 25	May 28	do	May 31	592	3	4	6	
78	981	May 26	May 29	May 30	June 1	981	3	4	6	
79	618	May 27	May 31	June 1	June 2	593	4	5	6	
80					June 3	25	4	5	7	
81	610	May 28	May 31	June 2	do	518	3	5	6	
82					June 4	92	3	5	7	
83	423	May 29	May 31	June 3	do	305	2	5	6	
84					June 5	118	2	5	7	
85	320	May 30	June 1	June 4	do	259	2	5	6	
86					June 6	61	2	5	7	
87	238	May 31	June 2	June 5	do	79	2	5	6	
88					June 7	159	2	5	7	
89	187	June 1	June 3	June 6	June 8	185	2	5	7	2
90	81	June 2	June 4	June 7	June 9	76	2	5	7	3
91	93	June 3	June 5	June 9	June 10	88	2	6	7	5
92					June 11	2	2	6	8	
93	112	June 4	June 6	June 10	do	112	2	6	7	
94	45	June 5	June 7	do	do	28	2	5	6	
95					June 12	17	2	5	7	
96	92	June 6	June 8	June 11	do	68	2	5	6	
97					June 13	24	2	5	7	
98	53	June 7	June 11	June 12	do	53	4	5	6	
99	47	June 8	June 10	do	do	33	2	4	5	
100					June 14	14	2	4	6	
101	20	June 9								20
102	22	June 10	June 12	June 14	June 15	13	2	4	5	
103					June 16	9	2	4	6	
Total	31,222					31,124				98
Average							3.41	8.16	9.88	

Length of incubation.—Observations to determine the length of the period of incubation of eggs of the first brood were begun April 13 and continued until June 10. (Table 54.) The average length of time from the date of deposition to the appearance of the red ring was 3.41 days, maximum 6, mimimum 2. The average length of time from deposition to the appearance of the black spot was 8.16 days, maximum 14, mimimum 4. The average period of incubation of 31,124 eggs was 9.88 days, maximum 17, mimimum 5.

LARVAE OF THE FIRST BROOD

Time of hatching.—The time of hatching of 31,124 eggs of the first brood is given in Table 54. The first eggs of this brood hatched on April 24, the last on June 16. Thus the period of incubation extended over 54 days. The maximum number of eggs, 2,706, hatched on May 23.

Length of the feeding period.—Table 55 presents the records of the feeding periods of 2,510 larvae of the first brood. The average length of the feeding period for the total number was 20.90 days, the maximum 39, the minimum 13.

TABLE 55.—*Length of feeding period of 2,510 larvae of the first brood of the codling moth, Cornelia, Ga., 1921*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																								
		13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	37	38	39
Apr. 24	4																				2		1	1			
Apr. 27	1																				1						
Apr. 28	10																		1	3	2		2	2			
Apr. 29	15																1	1	5	4	2	1			1		
Apr. 30	23																2	3	5	6	3	2				2	
May 1	6																	3	1		1				1		
May 2	3													1			1		1								
May 4	7											1		2	1	2		1									
May 5	2											1			1												
May 6	61									1	10	22	13	8	3		2	1						1			
May 7	71								1	4	19	15	9	9	5			4	2	1		2					
Apr. 8	39									6	11	7	9	2	1	3											
May 9	77								4	21	13	8	7	7	3	5	6				2					1	
May 10	64									4	10	8	16	4	6	5	7	2	2								
May 11	48									2	6	12	5	6	7	1	5	1	1	1							1
May 12	79									2	6	5	9	11	9	9	9	5	2	7	2		2	1			
May 13	65							2	1	3	11	13	4	5	11	7	3			4		1					
May 14	61							2	6	9	9	9	6	5	7		1	7									
May 15	37							1	2	2	6	8	6	4	1	3	2	2									
May 16	46							2	5	6	14	8	2	3	3		1		2								
May 17	37					3	11	5	11	2	2	2		1													
May 18	95				1	4	3	9	17	13	16	6	12	6	4	1	2				1						
May 19	104			5	17	21	15	14	4	8	5	5	5	3									1	1			
May 20	70				4	4	6	11	8	11	12	10	2	1					1								
May 21	65		4	4	8	16	9	10	7	3	1	1	2														
May 22	65	1	3	5	10	9	8	11	6	5	5	2															
May 23	88		3	11	16	3	7	17	15	1	5	3	1	2	1		1	1		1							
May 24	72			2	7	12	13	12	6	9	5	2	3		1												
May 25	73		2	5	9	17	17	10	3	3	5	1		1													
May 26	70		2	4	11	26	12	6	1	2	2	3		1													
May 27	59		1	14	10	12	10	3	3	2	2		1				1										
May 28	42		2	7	12	11	5	2	1						1	1											
May 29	24			1	6	6	4	3		3			1														
May 30	104					14	10	34	2	7	6	7	7	5	8	1		2					1				
May 31	98				4	16	24	11	7	6	12	4	1	6	3	1			2				1				
June 1	96				1	7	7	10	14	13	13	6	7	4	1	5	5		2	1							
June 2	107			2	13	20	17	11	20	11	6	5			1			1									
June 3	92			8		14	26	11	8	5	3	5	4		3	1	2	1			1						
June 4	77			3	4	8	12	17	10	4	6	2	4		2	2	2						1				
June 5	52					3	6	9	10	4	5	8	1	1	2			2					1				
June 6	73				2	9	3	14	12	7	8	8	6		1				2		1						
June 7	36				2	4	9	1	3	5	1	4	3	2	2												
June 8	38				5	9	8	7	4	3		2															
June 9	19		1		7	2	2	1	2	2	1	1															
June 10	25			1	7	9		4	1	1				1						1							
June 11	37		4	6	6	8	4	6	1		1						1										
June 12	31	1	1	5	9	5	4	1	2	1		1			1												
June 13	30			6	11	2	7	3									1										
June 14	7		1	1	4				1																		
June 15	1					1																					
June 16	4			2	1	1																					
Total	2,510	2	24	92	187	276	259	260	198	191	237	205	146	102	89	47	54	37	29	29	18	9	8	5	2	3	1

Length of the cocooning period.—Table 56 gives the results of observations on the cocooning period of 1,525 individuals. The cocooning period varies from 2 to 41 days, with an average of 7.7 days. It is determined as being the period from the time the larvae leave the fruit to the time of pupation.

TABLE 56.—*Length of cocooning period of 1,525 transforming larvae of the first brood of the codling moth, Cornelia, Ga., 1921*

Larvae entered fruit	Number of individuals	Number of individuals having cocooning periods [1] of specified number of days																					
		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Apr. 24	4		3										1										
Apr. 27	1			1																			
Apr. 28	10			3	3	3			1														
Apr. 29	15	2	2	4	3	2	1	1															
Apr. 30	22		1	11	2	2	1				2	1								1			
May 1	5			2	3																		
May 2	2		1	1																			
May 4	7		1	3	1			1			1												
May 5	2			1		1																	
May 6	56		3	14	15	6	1	2	3	1	1			2		1		1	1		1	2	
May 7	62			17	21	9	4	1	1	1			2	1		2	1	1					
May 8	36	2		12	12	3		1		2				1			1				1		
May 9	63		2	9	24	9	6	3	2	2							2		1	1	1		
May 10	54			3	14	10	7	4	1	1				1	3	1			1		3		
May 11	36			5	2	11	1	2	2		1	1	1		1				1	2		1	1
May 12	59		1	7	8	11	7	8		1	2	1	1	1	1	1			1	2	1	1	
May 13	49	1	3	5	11	4	4	1	1		4	1			1		1		3	2		2	3
May 14	41		2	4	8	7	3	5	1	1	1			2			3	1	1	1			1
May 15	24			4	3	2	2		3	1	2	2			1				1	1			
May 16	26			8	6	1		1			1		1		1	2	1					1	1
May 17	26		1	4	8	6	1	1		1		1						1	1				
May 18	58		1	13	12	6	7	1	1	2	3			2	3	1			1	1	1		1
May 19	79		2	12	16	13	14	4	1	1	1	1	2				1	1	2	1	1		1
May 20	48		2	20	8	4	1	1	1		2			2			4		1				
May 21	39	1		10	12	5	3		1					2						1	1		
May 22	46		1	7	16	5	1	2	4		1	2			1			2		1			
May 23	56		5	10	14	9	2	5	1	1	3		2		1		2						
May 24	45		1	5	5	9	7	5		4	1			1			2	1		2	1		
May 25	35		3	4	10	2	5	3	1		1				2			1					1
May 26	42		6	10	5	5	2		1	2	2	1	2	1		1		1			1		1
May 27	34		4	7	7	2	4	2	1		1		1	1	1	1	1						
May 28	25			9	7		2	1	2	1					1						1		
May 29	13		3	1	2	1			1	1			1	2			1						
May 30	47		1	8	14	3	6	3	4		1		1	2			1	1	1				
May 31	45		2	17	14	3	3	1	3												1		
June 1	49	2	3	11	12	4	3	2	2		2	3		1	1			1		1	1		
June 2	50		2	11	16	8	1	1	1	1	1		2				2			1			
June 3	48		3	19	14	3	1	4			1			1						1			
June 4	37	1	6	14	8	5	1				1			1									
June 5	21		3	8	2	3	1	1		1				1									
June 6	36	2	4	15	6	2	4					1										1	
June 7	8		1	2	3	1	1																
June 8	11		1	3	5		1								1								
June 9	3			1	1	1																	
June 10	12		4	5	1		1		1														
June 11	12		4	4	3	1																	
June 12	13	1	2	7	2		1																
June 13	7			3	3	1																	
June 14	4		1	1	2																		
June 15	1		1																				
June 16	1			1																			
Total or average	1,525	12	86	356	364	183	110	67	41	25	36	15	16	27	19	10	23	12	15	20	12	11	10

[1] Time from leaving the fruit to the time of pupation.

TABLE 56.—*Length of cocooning period of 1,525 transforming larvae of the first brood of the codling moth, Cornelia, Ga., 1921*—Continued

Larvae entered fruit	Number of individuals	Number of individuals having cocooning periods of specified number of days																Average	Maximum	Minimum
		24	25	26	27	28	29	30	31	33	34	35	36	37	39	40	41			
																		Days	*Days*	*Days*
Apr. 24	4																	5.50	13	3
Apr. 27	1																	4.00	4	4
Apr. 28	10																	5.40	9	4
Apr. 29	15																	4.53	8	2
Apr. 30	22	1																7.00	24	3
May 1	5																	4.60	5	4
May 2	2																	3.50	4	3
May 4	7																	5.57	11	3
May 5	2																	5.00	6	4
May 6	56		1				1											7.98	29	3
May 7	62				1													6.71	27	4
May 8	36		1															6.53	25	2
May 9	63		1															6.97	25	3
May 10	54	1	2						1			1						10.06	35	4
May 11	36	1		1	1		1											11.06	29	4
May 12	59				1	1		1	1									9.66	31	3
May 13	49		2															10.27	25	2
May 14	41																	8.63	23	3
May 15	24													1			1	11.33	41	4
May 16	26	1														1		10.50	40	4
May 17	26	1																7.42	24	3
May 18	58						1							1				8.76	37	3
May 19	79		1	1				1				1						8.58	35	3
May 20	48	1	1															7.50	25	3
May 21	39	1			1								1					8.15	36	2
May 22	46						1	2										8.59	30	3
May 23	56														1			7.13	39	3
May 24	45						1											8.84	29	3
May 25	35		1		1													8.26	27	3
May 26	42	1																7.90	24	3
May 27	34			1														7.41	26	3
May 28	25										1							7.64	34	4
May 29	13																	8.15	17	3
May 30	47									1								7.74	33	3
May 31	45								1									6.00	31	3
June 1	49																	6.98	21	2
June 2	50						2		1									7.84	31	3
June 3	48		1															5.88	25	3
June 4	37																	4.81	14	2
June 5	21				1													6.43	27	3
June 6	36				1													5.75	27	2
June 7	8																	4.87	7	3
June 8	11																	5.64	15	3
June 9	3																	5.00	6	4
June 10	12																	4.42	9	3
June 11	12																	4.08	6	3
June 12	13																	4.08	7	2
June 13	7																	4.71	6	4
June 14	4																	4.25	5	3
June 15	1																	3.00	3	3
June 16	1																	4.00	4	4
Total or average	1,525	8	11	3	7	1	7	4	4	1	1	2	1	2	1	1	1	7.70	------	------

Percentage of transforming and wintering larvae.—Of the 2,510 first-brood larvae reared in the insectary, 1,710, or 68.13 per cent, transformed the same season. The percentage wintering was 31.87.

PUPAE OF THE FIRST BROOD

Time of pupation.—The earliest pupation of the first brood, as shown in Table 57, was recorded on May 29, and the last pupation occurred on July 25.

TABLE 57.—*Time of pupation of 1,536 transforming larvae of the first brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
May 29	2	June 12	90	June 26	45	July 10	10
May 30	2	June 13	71	June 27	47	July 11	7
May 31	3	June 14	49	June 28	47	July 13	1
June 1	15	June 15	47	June 29	38	July 14	1
June 2	24	June 16	33	June 30	43	July 16	3
June 3	36	June 17	72	July 1	27	July 17	6
June 4	56	June 18	38	July 2	17	July 18	4
June 5	21	June 19	32	July 3	13	July 19	1
June 6	42	June 20	33	July 4	37	July 20	4
June 7	27	June 21	28	July 5	27	July 21	1
June 8	38	June 22	53	July 6	4	July 22	1
June 9	52	June 23	50	July 7	4	July 25	1
June 10	45	June 24	52	July 8	12		
June 11	61	June 25	57	July 9	6	Total	1,536

Length of the pupal stage.—The pupal period of 1,333 pupae under observation varied from 7 to 33 days, with an average of 11.16 days. (Table 58.)

TABLE 58.—*Length of the pupal stage of 1,333 pupae of the first brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days												
		7	8	9	10	11	12	13	14	15	16	17	19	20	33
May 29	2						1							1	
May 30	2						1	1							
May 31	3						1	2							
June 1	14					3	9	1	1						
June 2	24					9	15								
June 3	35				1	11	20	2	1						
June 4	46					12	25	7		1					1
June 5	21	1				9	10		1						
June 6	37				3	22	12								
June 7	22				3	14	4					1			
June 8	30				3	27									
June 9	48			1	23	1	21	1			1				
June 10	38			1		27	8	2							
June 11	54			1	13	29	9		1				1		
June 12	85			5	9	27	34	5	5						
June 13	61		1		6	22	30	1	1						
June 14	42			2	4	17	16	1	1			1			
June 15	41			3	5	15	18								
June 16	29				4	15	7	2	1						
June 17	63		1		2	13	43	3	1						
June 18	31			1		6	23		1						
June 19	21				2	9	5	4		1					
June 20	26				4	12	9	1							
June 21	21				4	15	2								
June 22	44			4	7	28	4	1							
June 23	42			2	17	22	1								
June 24	45		1	2	19	22	1								
June 25	50		1	5	14	27	3								
June 26	40	1		4	24	11									
June 27	43		2	4	20	13	3	1							
June 28	40		1	2	13	21	3								
June 29	36		1	6	12	12	4	1							
June 30	4		2	4	17	15	3								
July 1	25			1	8	12	4								
July 2	15		1	2	1	5	6								
July 3	12		1		2	7	2								
July 4	30		4	1	2	10	11	2							
July 5	21			1	1	6	10	3							
July 6	4				1		1	1	1						
July 7	4					1	2		1						
July 8	9			1		5	2					1			
July 9	5			1		1	1	2							

TABLE 58.—*Length of the pupal stage of 1,333 pupae of the first brood of the codling moth, Cornelia, Ga., 1921*—Continued

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days												
		7	8	9	10	11	12	13	14	15	16	17	19	20	33
July 10	8					2	1	5							
July 11	7					1	1	3	1	1					
July 14	1							1							
July 16	3						1	1	1						
July 17	5				1	3		1							
July 18	3		1		1	1									
July 19	1		1												
July 20	2					1	1								
July 25	1				1										
Total	1,333	2	18	54	247	541	388	55	18	3	2	2	1	1	1

MOTHS OF THE FIRST BROOD

Time of emergence.—The first moths of this brood began to emerge on June 10, the last emerged on August 11; the emergence period covered 63 days. The great majority of the moths emerged from June 21 to July 10. (Table 59.)

TABLE 59.—*Time of emergence of 1,346 codling moths of the first brood, from material reared at the insectary, Cornelia, Ga., 1921*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 10	1	June 25	61	July 10	36	July 25	1
June 11	1	June 26	37	July 11	29	July 26	3
June 12	5	June 27	38	July 12	23	July 27	5
June 13	20	June 28	20	July 13	11	July 28	5
June 14	25	June 29	53	July 14	17	July 29	2
June 15	32	June 30	41	July 15	13	July 30	3
June 16	41	July 1	27	July 16	18	July 31	1
June 17	43	July 2	39	July 17	13	Aug. 1	1
June 18	32	July 3	53	July 18	7	Aug. 4	1
June 19	58	July 4	49	July 19	8	Aug. 9	1
June 20	1	July 5	46	July 20	4	Aug. 10	1
June 21	69	July 6	59	July 21	5	Aug. 11	1
June 22	47	July 7	38	July 22	4		
June 23	49	July 8	34	July 23	7	Total	1,346
June 24	64	July 9	39	July 24	4		

Time of oviposition.—According to Table 60, the first eggs were deposited June 8, and the last August 11. The maximum egg laying occurred about June 25. The average period of oviposition was 11.51 days, maximum 16, minimum 1. The average time from the date of emergence of the moth to the end of the oviposition period was 12.15 days, maximum 17, minimum 2.

TABLE 60.—*Oviposition by 464 codling moths of the first brood in rearing cages, Cornelia, Ga., 1921*

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
1	1		1	June 4	June 8		468			
	1		1	June 5						
	1	1		June 6						
	1	1		June 7						
	1	1		June 8						
	1		1	June 9						
	5	2	3	June 10						
	3	1	2	June 11						
2	11	5	6	June 12	June 13	June 19	70	1	7	7
3	20	10	10	June 13	June 14	June 25	639	1	12	12
4	22	10	12	June 14	June 16	June 28	1,261	2	13	14
5	30	15	15	June 15	June 16	June 30	1,792	1	15	15
6	25	12	13	June 16	June 17	June 27	1,029	1	11	11
7	27	12	15	June 17	June 19	July 1	1,220	2	13	14
8	18	9	9	June 18	June 20	July 3	920	2	14	15
9	30	15	15	June 19	June 21	July 5	2,279	2	15	16
10	26	13	13	June 21	June 22	do	1,642	1	14	14
11	25	15	10	June 22	June 23	July 6	1,332	1	14	11
12	25	12	13	June 23	June 25	July 4	1,586	2	10	11
13	24	10	14	June 24	June 26	July 11	1,978	2	16	17
14	28	13	15	June 25	do	July 7	1,563	1	12	12
15	29	14	15	June 26	June 28	July 8	1,155	2	11	12
16	30	15	15	June 27	June 29	do	906	2	10	11
17	29	14	15	June 28	June 30	July 11	667	2	12	13
18	24	12	12	June 29	do	July 12	757	1	13	13
19	27	14	13	June 30	July 1	July 11	373	1	11	11
20	30	15	15	July 1	July 2	July 12	656	1	11	11
21	28	13	15	July 2	July 3	July 13	1,430	1	11	11
22	29	14	15	July 3	July 5	July 14	389	2	10	11
23	30	15	15	July 4	July 6	July 16	435	2	11	12
24	30	15	15	July 5	do	July 17	1,156	1	12	12
25	27	13	14	July 6	July 7	July 15	904	1	9	9
26	28	15	13	July 7	July 8	July 21	1,259	1	14	14
27	30	17	13	July 8	July 10	July 20	732	2	11	12
28	29	15	14	July 9	July 11	July 26	1,152	2	16	17
29	31	16	15	July 10	do	July 18	422	1	8	8
30	26	13	13	July 11	July 14	July 25	530	3	12	14
31	18	9	9	July 12	do	July 21	246	2	8	9
32	9	6	3	July 13	July 15	July 22	232	2	8	9
33	15	7	8	July 14	July 16	July 26	568	2	11	12
34	11	5	6	July 15	July 17	July 24	300	2	8	9
35	11	5	6	July 16	July 19	July 27	644	3	9	11
36	14	7	7	July 17	do	July 28	750	2	10	11
37	7	2	5	July 18	July 20	July 30	291	2	11	12
38	8	4	4	July 19	July 21	July 26	213	2	6	7
39	6	4	2	July 20	July 22	July 30	235	2	9	10
40	6	3	3	July 21	July 24	Aug. 2	276	3	10	12
41	5	2	3	July 22	do	July 30	127	2	7	8
42	4	2	2	July 23	July 26	Aug. 2	62	3	8	10
43	3	2	1	July 24						
44	2	1	1	July 25						
45	2	1	1	July 26	Aug. 4	Aug. 4	12	9	1	9
46	4	3	1	July 27	July 29	Aug. 3	93	2	6	7
47	5	2	3	July 28	July 30	Aug. 2	93	2	4	5
48	2	1	1	July 29						
49	2	1	1	July 30	Aug. 1	Aug. 3	27	2	3	4
50	1	1		July 31						
51	1		1	Aug. 1						
52	2	1	1	Aug. 4	Aug. 6	Aug. 6	2	2	1	2
53	1	1		Aug. 9						
54	1	1		Aug. 10						
55	1	1		Aug. 11						
Total	923	459	464				34,873			
Average								1.64	11.51	12.15

Number of eggs per female moth.—Moths of this brood deposited a greater number of eggs than did the spring-brood moths, the average for 464 moths being 75.16 eggs.

Length of life of moths.—The average length of life of 453 male moths was 9.93 days; of 456 female moths, 9.77 days. (Table 61.)

TABLE 61.—*Length of life of 453 male and 456 female codling moths of the first brood in captivity, Cornelia, Ga., 1921*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*			*Days*		
1	2	4	9	36	55	17	9	3
2	12	8	10	47	58	18	6	1
3	19	10	11	36	61	19	7	5
4	11	11	12	30	45	20	3	1
5	16	11	13	35	35	21	3	0
6	30	25	14	22	12			
7	40	32	15	16	17	Total	453	456
8	51	51	16	22	11			

Summary of the first generation.—A summary of results from observations on the separate stages of the first generation of the codling moth shows the average length of the complete life cycle to be 51.28 days. (Table 62.)

TABLE 62.—*Summary of results from experiments on the separate stages of the first generation of the codling moth, Cornelia, Ga., 1921*

Stages of complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	9.88	17	5
Feeding period of larvae	20.90	39	13
Making of cocoons	7.70	41	2
Pupal stage	11.16	33	7
Time before egg deposition	1.64	9	1
Total	51.28		
Length of life of male moths	9.93	21	1
Length of life of female moths	9.77	20	1
Average number of eggs per female moth, 75.16.			

THE SECOND GENERATION

EGGS OF THE SECOND BROOD

Time of deposition.—The first eggs of this brood were deposited June 8. The period of deposition extended over 57 days, during which time 34,873 eggs were under observation. The great majority of the eggs were laid between June 20 and July 5. (Table 63.)

TABLE 63.—*Time of deposition, length of incubation, and time of hatching of 34,873 eggs of the second brood of the codling moth, Cornelia, Ga., 1921*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
1	18	June 8	June 10	June 12	June 13	9	2	4	5	2
2					June 14	7	2	4	6	
3	38	June 9	June 11	June 13	---do----	36	2	4	5	2
4	3	June 10	June 12	June 14	June 16	3	2	4	6	
5	4	June 11	June 13	June 15	June 16	2	2	4	5	
6					June 17	2	2	4	6	
7	101	June 12	June 13	June 16	---do----	101	1	4	5	
8	35	June 13	June 14	June 17	June 18	35	1	4	5	
9	100	June 14	June 15	June 18	June 19	90	1	4	5	
10					June 20	10	1	4	6	
11	220	June 15	June 17	June 19	---do----	106	2	4	5	
12					June 21	114	2	4	6	
13	403	June 16	June 18	June 20	June 22	403	2	4	6	
14	485	June 17	June 19	June 22	June 23	466	2	5	6	
15					June 24	19	2	5	7	
16	473	June 18	June 20	June 23	---do----	435	2	5	6	
17					June 25	38	2	5	7	
18	367	June 19	June 22	June 24	---do----	367	3	5	6	
19	401	June 20	June 23	June 25	June 26	401	3	5	6	
20	1,292	June 21	June 24	---do----	---do----	1,163	3	4	5	
21					June 27	129	3	4	6	
22	1,310	June 22	June 24	June 26	---do----	1,258	2	4	5	
23					June 28	52	2	4	6	
24	1,689	June 23	June 25	June 27	---do----	1,503	2	4	5	
25					June 29	186	2	4	6	
26	1,447	June 24	June 26	June 28	---do----	1,302	2	4	5	
27					June 30	145	2	4	6	
28	1,156	June 25	June 27	June 29	---do----	1,098	2	4	5	
29					July 1	58	2	4	6	
30	1,476	June 26	June 28	June 30	---do----	1,402	2	4	5	
31					July 2	44	2	4	6	
32					July 3	30	2	4	7	
33	1,866	June 27	June 29	July 1	July 2	1,810	2	4	5	
34					July 3	56	2	4	6	
35	1,684	June 28	June 30	July 2	---do----	1,633	2	4	5	
36					July 4	34	2	4	6	17
37	1,764	June 29	July 1	July 3	---do----	1,764	2	4	5	
38	1,235	June 30	July 2	July 4	July 5	1,235	2	4	5	
39	1,333	July 1	July 3	July 5	July 6	1,333	2	4	5	
40	767	July 2	July 4	July 6	July 7	767	2	4	5	
41	1,041	July 3	July 5	July 7	July 8	1,041	2	4	5	
42	1,024	July 4	July 6	July 8	July 9	881	2	4	5	
43					July 10	72	2	4	6	71
44	699	July 5	July 7	July 9	---do----	685	2	4	5	
45					July 11	14	2	4	6	
46	556	July 6	July 8	July 10	---do----	489	2	4	5	
47					July 12	67	2	4	6	
48	528	July 7	July 9	July 11	---do----	375	2	4	5	
49					July 13	153	2	4	6	
50	740	July 8	July 10	July 13	July 14	652	2	5	6	
51					July 15	81	2	4	7	7
52	720	July 9	July 11	July 14	---do----	677	2	5	6	
53					July 16	43	2	4	7	
54	931	July 10	July 12	July 15	---do----	866	2	5	6	
55					July 17	65	2	4	7	
56	1,005	July 11	July 14	July 16	---do----	1,005	3	5	6	
57	308	July 12	July 15	July 17	July 18	305	3	5	6	3
58	1,016	July 13	July 16	July 18	July 19	925	3	5	6	
59					July 20	20	3	5	7	71
60	959	July 14	July 17	July 19	---do----	949	3	5	6	10
61	688	July 15	---do----	July 20	July 21	660	2	5	6	
62					July 22	21	2	5	7	7
63	582	July 16	July 18	July 21	---do----	570	2	5	6	
64					July 23	6	2	5	7	6
65	455	July 17	July 19	July 22	---do----	445	2	5	6	
66					July 24	10	2	5	7	
67	520	July 18	July 20	July 23	---do----	395	2	5	6	
68					July 25	99	2	5	7	26
69	455	July 19	July 21	July 24	---do----	355	2	5	6	
70					July 26	86	2	5	7	14
71	253	July 20	July 22	July 25	---do----	232	2	5	6	
72					July 27	18	2	5	7	3

TABLE 63.—*Time of deposition, length of incubation, and time of hatching of 34,873 eggs of the second brood of the codling moth, Cornelia, Ga., 1921*—Continued

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
73	498	July 21	July 23	July 26	July 27	463	2	5	6	------
74					July 28	35	2	5	7	------
75	322	July 22	July 24	July 27	---do-----	322	2	5	6	------
76	316	July 23	July 25	July 28	---do-----	174	2	5	5	------
77					July 29	133	2	5	6	9
78	202	July 24	July 26	July 28	---do-----	156	2	4	5	------
79					July 30	46	2	4	6	------
80	219	July 25	July 27	July 29	---do-----	193	2	4	5	------
81					July 31	26	2	4	6	------
82	432	July 26	July 28	July 30	---do-----	432	2	4	5	------
83	133	July 27	---do-----	---do-----	Aug. 1	130	1	3	5	3
84	164	July 28	July 30	Aug. 1	Aug. 2	142	2	4	5	------
85					Aug. 3	17	2	4	6	5
86	106	July 29	July 31	Aug. 2	---do-----	94	2	4	5	------
87					Aug. 4	12	2	4	6	------
88	131	July 30	Aug. 2	Aug. 3	---do-----	120	3	4	5	11
89	93	July 31	---do-----	Aug. 4	Aug. 5	92	2	4	5	------
90					Aug. 6	1	2	4	6	------
91	10	Aug. 1	Aug. 3	Aug. 6	Aug. 7	10	2	5	6	------
92	79	Aug. 2	Aug. 4	Aug. 7	Aug. 8	79	2	5	6	------
93	7	Aug. 3	Aug. 5	----------	----------	------	------	------	------	7
94	2	Aug. 6	----------	----------	----------	------	------	------	------	2
95	12	Aug. 4	Aug. 6	Aug. 8	----------	------	2	4	------	12
Total	34,873	----------	----------	----------	----------	34,585	------	------	------	288
Average	------	----------	----------	----------	----------	------	2.15	4.32	5.39	------

Length of incubation.—The average incubation period for 34,585 eggs of this brood is very short, being 5.39 days; the maximum was 7, the minimum 5. The red ring appeared 2.07 days after egg deposition, and the black spot 4.37 days after egg deposition, on the average. (Table 63.)

LARVAE OF THE SECOND BROOD

Time of hatching.—According to the insectary records as tabulated in Table 63, the second brood of eggs began to hatch June 13 and continued to hatch until August 8. The majority of the eggs hatched from June 26 to July 9.

Length of the feeding period.—Larvae commenced to enter the fruit on June 13. The observations taken over a period of 57 days covered 1,850 individuals. The average feeding period was 19.05 days, maximum 36, minimum 12. (Table 64.)

TABLE 64.—*Length of feeding period of 1,850 larvae of the second brood of the codling moth, Cornelia, Ga., 1921*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																					
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	36
June 13	3			1			1																	
June 14	20				8	3	5	2				1	1											
June 16	2						1	1																
June 17	32			2	9		11	3	3	4														
June 18	7			1		1	3	1				1												
June 19	21			2	7	5	2	1		2	1		1											
June 20	16			3	4	4	3	1	1															
June 21	54		4	10	16	10	5		5	3								1						
June 22	87		1	14	20	9	13	9	9		2	2	3		1		1	1	1	1				
June 23	63		2	3	10	9	6	8	5	3	6	3	1		5			1			1			
June 24	82	1	3	6	10	18	18	7	7	3	1		1			3	1	1			2			
June 25	69	1	2	12	13	15	7	8	5	1	2		2		1									
June 26	68		6	6	17	9	3	8	4	2	5	2		2			3					1		
June 27	78		2	2	9	10	17	12	8	8	2		3	1	1	1	1							1
June 28	94	1	1	4	9	17	8	12	18	3	10	1	2	4	1			2	1					
June 29	77			4	9	10	7	12	7	7	7	5	3	1					2	3				
June 30	33				2	6	8	1	5	3	2		3	2	1									
July 1	61			1	2	6	10	8	10	10	7		4		3									
July 2	15				3	1	5	2	2		2													
July 3	18					1	3	2	1	4	2	3	2											
July 4	21							1	2	5		2		2	4	1	1			3				
July 5	43				1	2	4	5	7	10	6	3	1	1		2			1					
July 6	37					2	2	2	3	9		10	2	2	4	1								
July 7	52					3	4	6	7	14	8	4	1		4		1							
July 8	61				1		4	3	16	17	5	3	5	4	1					2				
July 9	71					1	7	9	10	14	6	7	10	1	1	3			2					
July 10	36					2	1	7	9	6	2	3	2	1		3								
July 11	44			2	2			7	7	8	7				2	3		3	1	1		1		
July 12	20							1	4	8	4		1	2										
July 13	31					1		1	3	4	7		4	3	1	1	2	2	1		1			
July 14	51					2	1	12	13	5	5	4	2	2		4				1				
July 15	46					2	8		21	2	2	2	3	2		1		1		1			1	
July 16	24						1	2	6	1	3	4	2	1		2		2						
July 17	20					1	5	2	3	2	2	1	2		1	1								
July 18	8							1	1	1	2	1	1			1								
July 19	7						2	1		2	1			1										
July 20	32						2	6	4	7	4	3	3	2					1					
July 21	24				1	1	4	5	5	3	1	1	1			1	1							
July 22	21					2	2	4	5	2	3		1			1				1				
July 23	15					2	3	3	4		2	1												
July 24	6								1	2	1			1				1						
July 25	36				2	6	3	7	8	4	4			1		1								
July 26	33				4	2	8	10	2	1	2	2	2											
July 27	42		1		3	8	12	6	4	2	2	2			2									
July 28	43					1	2	6	3	7	9	5	1	3	1	1	3				1			
July 29	30				2	2	4	6	3	7	2	2	2											
July 30	25					1	2	2	3	7	4	1	2	1	2									
July 31	30						2	1	6	6	5	6	2		1							1		
Aug. 1	15								2	5	4	1	2					1						
Aug. 2	8									1	3	1				1			1		1			
Aug. 3	7						1			1		1		2	1			1						
Aug. 4	5							1		1		1				1	1							
Aug. 5	1										1													
Aug. 8	6						1	2	1		1		1											
Total	1,850	3	22	73	164	175	221	217	253	217	157	89	79	42	38	33	15	17	11	13	3	5	2	1

Length of the cocooning period.—The results of observations of 707 larvae, as shown in Table 65, give a range of from 1 to 27 days in the length of the cocooning period, and an average of 6.07 days.

TABLE 65.—*Length of cocooning period of 707 transforming larvae of the second brood of the codling moth, Cornelia, Ga., 1921*

Larvae left fruit	Number of individuals	Number of individuals having cocooning periods[1] of specified number of days																							Average	Maximum	Minimum
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	26	27			
																												Days	*Days*	*Days*
June 27	1			1																								3.00	3	3
June 29	7			7																								3.00	3	3
June 30	4			2	1					1																		4.75	9	3
July 1	7			2	4	1																						3.86	5	3
July 2	11			3	8																							3.73	4	3
July 3	2			2																								3.00	3	3
July 4	27		3	6	14	2	1											1										4.19	17	2
July 5	21			5	8	5	3																					4.29	6	3
July 6	38		1	2	16	9	3		2	2	1	1		1														5.34	13	2
July 7	31	1		7	12	3	2	2							2											2		6.16	26	1
July 8	24			6	1	6	3	2	4			1								1								6.08	19	3
July 9	39		1	1	9	6	5		8	2	1					1	1		1		1		1		1	1		7.95	24	2
July 10	42			1	12	9	12	2		2	1			1					1		1							6.21	20	3
July 11	50					26	11	3	2	2		4							1				1					6.70	22	5
July 12	31				2	14	3	9			2		1															6.16	12	4
July 13	25			2	5	10	2	2	2		1		1															5.60	12	3
July 14	40			1	9	11	1	7	3	1	1	2	1					1		1								6.90	19	3
July 15	21				4	9	3	1	1	1				1				1										6.33	17	4
July 16	23					8	5	3		1	3	2					1											7.30	16	5
July 17	32			1	5	9	9	4	2	1			1															5.84	12	3
July 18	16				1	5	4	2	1	1	1															1			7.38	24	4
July 19	21				1	3	6	7	3		1																		6.57	10	4
July 20	11					4	1	3	2	1																		6.55	9	5
July 21	12				1	3	4	1		1		2																6.75	11	4
July 22	11					9		1		1																		6.55	9	5
July 23	9			1	3	2	1		1	1																		5.33	9	3
July 24	14			1	4	1	3	1	1	1							1	1										7.07	17	3
July 25	13				4	4	3	2																				5.23	7	4
July 26	10				3	3	4																					5.10	6	4
July 27	18				10	1	3		2	1													1					6.06	21	4
July 28	15		2	2	4	2	2	2							1													5.07	14	2
July 29	15			1	6	1	4		1	1				1														5.73	13	3
July 30	4				2	1	1																					4.75	6	4
July 31	8				3	2	1	1							1													6.12	14	4
Aug. 1	9		1		1	2		3		1		1																6.33	11	2
Aug. 2	5						4								1													7.80	15	6
Aug. 3	17				4	4	2	3	1		2																1	7.41	27	4
Aug. 4	4						3	1																				6.25	7	6
Aug. 5	1						1																					6.00	6	6
Aug. 6	3				2				1																			5.33	8	4
Aug. 7	4					1		3																				6.50	7	5
Aug. 8	2						2																					6.00	6	6
Aug. 9	2					1	1																					5.50	6	5
Aug. 10	1				1																							4.00	4	4
Aug. 11	1					1																						5.00	5	5
Aug. 13	1					1																						5.00	5	5
Aug. 15	2					1	1																					5.50	6	5
Aug. 16	1				1																							4.00	4	4
Aug. 20	1					1																						5.00	5	5
Total or average	707	1	8	54	161	181	114	65	37	22	12	14	5	5	4	2	3	4	3	2	1	2	1	1	2	2	1	6.07	------	------

[1] Time from leaving the fruit to the time of pupation.

Percentage of transforming and wintering larvae.—Of 1,850 second-brood larvae under observation, 807 pupated. This shows that 43.62 per cent transformed and 56.38 per cent wintered.

PUPAE OF THE SECOND BROOD

Time of pupation.—The daily observations of the time of pupation of the second brood are tabulated in Table 66. This table shows that 709 larvae were under observation and that the earliest pupation occurred on June 30 and the latest on August 30, thus covering about two months.

TABLE 66.—*Time of pupation of 709 transforming larvae of the second brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
June 30	1	July 15	17	July 29	11	Aug. 12	2
July 2	7	July 16	48	July 30	15	Aug. 14	11
July 3	2	July 17	42	July 31	22	Aug. 15	1
July 4	3	July 18	26	Aug. 1	20	Aug. 16	1
July 5	8	July 19	33	Aug. 2	17	Aug. 17	2
July 6	14	July 20	17	Aug. 3	6	Aug. 18	1
July 7	6	July 21	28	Aug. 4	12	Aug. 20	2
July 8	20	July 22	26	Aug. 5	5	Aug. 21	1
July 9	13	July 23	21	Aug. 6	4	Aug. 30	1
July 10	30	July 24	15	Aug. 7	6		
July 11	32	July 25	19	Aug. 8	11	Total	709
July 12	8	July 26	19	Aug. 9	3		
July 13	18	July 27	28	Aug. 10	10		
July 14	25	July 28	13	Aug. 11	6		

Length of the pupal stage.—From a total of 624 individual insects under observation, the results show that the pupal period varied from 7 to 16 days, with an average of 11.47 days. (Table 67.)

TABLE 67.—*Length of the pupal stage of 624 pupae of the second brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days									
		7	8	9	10	11	12	13	14	15	16
June 30	1			1							
July 2	7			2	5						
July 3	2					2					
July 4	3				1	1	1				
July 5	8				2	6					
July 6	12			1	4	6		1			
July 7	5				1	3	1				
July 8	18			1	1	11	5				
July 9	11					6	4	1			
July 10	28					6	14	8			
July 11	27					3	7	15	2		
July 12	8						5	3			
July 13	17				1	5	9	2			
July 14	21					4	11	5		1	
July 15	16					4	10	1	1		
July 16	46					11	26	7	2		
July 17	38				1	10	20	7			
July 18	22					5	14	3			
July 19	30				1	9	17	3			
July 20	15				1	6	7	1			
July 21	24				3	10	11				
July 22	22			1	2	15	4				
July 23	17				10	7					
July 24	13				7	6					
July 25	14			2	10	1	1				
July 26	17		2	6	1	7	1				
July 27	27		2	1	6	14	3	1			
July 28	11			2	1	5	3				
July 29	10				3	4	3				
July 30	10				2	4	3	1			
July 31	21			3	3	5	9	1			
Aug. 1	16				2	5	8	1			
Aug. 2	17	1		1	1	4	5	3	1	1	
Aug. 3	5						3	2			
Aug. 4	9				1			6	1		1
Aug. 5	5							3	2		
Aug. 6	4						1	2	1		
Aug. 7	5							3	1	1	
Aug. 8	8						1	5	2		
Aug. 9	1						1				
Aug. 10	9				1	4	4				
Aug. 11	4			1		2	1				
Aug. 12	2			1		1					
Aug. 14	11		1	1		4	2	1	1	1	
Aug. 15	1					1					
Aug. 16	1							1			
Aug. 17	1						1				
Aug. 20	2							2			
Aug. 21	1						1				
Aug. 30	1				1						
Total	624	1	5	24	72	200	227	82	9	3	1

MOTHS OF THE SECOND BROOD

Time of emergence.—The first moths of the second brood from insectary-reared material issued July 9. The last moth emerged September 9, and the maximum number of moths emerged between July 22 and August 4. (Table 68.)

TABLE 68.—*Time of emergence of 639 codling moths of the second brood, Cornelia, Ga., 1921*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
July 9	1	July 25	18	Aug. 8	12	Aug. 22	7
July 11	2	July 26	17	Aug. 9	14	Aug. 23	4
July 12	5	July 27	27	Aug. 10	11	Aug. 25	5
July 14	3	July 28	37	Aug. 11	11	Aug. 26	3
July 15	4	July 29	33	Aug. 12	18	Aug. 27	1
July 16	11	July 30	35	Aug. 13	12	Aug. 28	1
July 17	8	July 31	30	Aug. 14	7	Aug. 29	3
July 18	4	Aug. 1	23	Aug. 15	6	Aug. 31	1
July 19	13	Aug. 2	38	Aug. 16	4	Sept. 2	3
July 20	11	Aug. 3	22	Aug. 17	11	Sept. 7	1
July 21	10	Aug. 4	24	Aug. 18	5	Sept. 9	1
July 22	18	Aug. 5	3	Aug. 19	6		
July 23	16	Aug. 6	18	Aug. 20	9	Total	639
July 24	25	Aug. 7	17	Aug. 21	10		

Time of oviposition.—On the average, the moths oviposited two days after emergence, the maximum period was 4 days, the minimum 1. The length of the oviposition period of 265 moths ranged from 1 to 17 days, with an average of 9.5 days. The length of time from the date of emergence of the moths to the last oviposition varied from 4 to 17 days, with an average of 11.76. (Table 69.)

TABLE 69.—*Oviposition by 265 codling moths of the second brood in rearing cages, Cornelia, Ga., 1921*

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
1	1	1	0	July 9	July 15		438			
	2	2	0	July 11						
	3	1	2	July 12						
	2	2	0	July 14						
	5	2	3	July 15						
2	11	5	6	July 16	July 18	July 24	373	2	7	8
3	7	4	3	July 17	July 19	do	135	2	6	7
4	6	3	3	July 18	July 21	July 26	166	3	6	8
5	14	7	7	July 19	do	July 29	612	2	9	10
6	10	7	3	July 20	July 22	July 31	226	2	10	11
7	14	7	7	July 21	July 24	Aug. 2	465	3	10	12
8	15	7	8	July 22	do	Aug. 6	844	2	14	15
9	14	8	6	July 23	July 25	Aug. 4	838	2	11	12
10	21	10	11	July 24	July 26	do	970	2	10	11
11	22	9	13	July 25	July 27	Aug. 6	1,075	2	11	12
12	13	6	7	July 26	do	do	615	1	11	11
13	28	16	12	July 27	July 28	Aug. 11	1,962	1	15	15
14	27	11	16	July 28	July 29	Aug. 10	2,086	1	13	13
15	23	10	13	July 29	July 30	Aug. 13	1,665	1	15	15
16	28	13	15	July 30	Aug. 1	Aug. 8	864	2	8	9
17	22	9	13	July 31	Aug. 2	Aug. 11	881	2	10	11
18	18	8	10	Aug. 1	do	Aug. 17	896	1	16	16
19	29	15	14	Aug. 2	Aug. 3	Aug. 19	1,069	1	17	17
20	13	8	5	Aug. 3	Aug. 5	do	440	2	15	16
21	19	11	8	Aug. 4	Aug. 7	Aug. 17	834	3	11	13
22	4	3	1	Aug. 5	do	do	159	2	11	12
23	9	4	5	Aug. 6	Aug. 9	Aug. 18	811	3	10	12
24	14	7	7	Aug. 7	do	Aug. 20	1,153	2	12	13
25	11	6	5	Aug. 8	do	Aug. 18	710	1	10	10
26	11	6	5	Aug. 9	Aug. 11	Aug. 20	410	2	10	11
27	7	4	3	Aug. 10	Aug. 12	Aug. 17	424	2	6	7
28	10	6	4	Aug. 11	Aug. 13	Aug. 19	568	2	7	8
29	16	10	6	Aug. 12	do	Aug. 21	660	1	9	9
30	9	6	3	Aug. 13	Aug. 16	Aug. 27	356	3	12	14

TABLE 69.—*Oviposition by 265 codling moths of the second brood in rearing cages, Cornelia, Ga., 1921*—Continued

Cage No.	Number of moths	Sex		Date of—			Number of eggs deposited	Number of days—		
		Male	Female	Emergence	First oviposition	Last oviposition		Before oviposition	Of oviposition period	From emergence to last oviposition
31	6	3	3	Aug. 14	Aug. 16	Aug. 21	159	2	6	7
32	8	4	4	Aug. 15	Aug. 18	Aug. 23	328	3	6	8
33	4	3	1	Aug. 16	Aug. 19	Aug. 25	128	3	7	9
34	8	4	4	Aug. 17	do	Aug. 28	330	2	10	11
35	2	0	2	Aug. 18						
36	5	0	5	Aug. 19	Aug. 21	Aug. 27	86	2	7	8
37	3	0	3	Aug. 20	Aug. 23	Aug. 28	318	3	6	8
38	6	4	2	Aug. 21	Aug. 25	Aug. 25	9	4	1	4
39	6	3	3	Aug. 22	Aug. 24	Sept. 2	461	2	10	11
40	4	0	4	Aug. 23						
41	6	3	3	Aug. 25	Aug. 28	Sept. 2	179	3	6	8
42	2	1	1	Aug. 26	do	do	37	2	6	7
43	2	0	2	Aug. 27	Aug. 31	do	72	4	3	6
44	1	0	1	Aug. 29						
45	2	0	2	Sept. 2						
46	1	0	1	Sept. 4						
47	1	1	0	Sept. 7						
Total	525	260	265				24,812			
Average								1.85	10.91	11.76

Number of eggs per female moth.—The number of eggs deposited by 265 female moths was 24,812, or an average of 93.63 per moth. (Table 69.)

Length of life of moths.—The 252 male moths lived an average of 11.81 days, maximum 23, minimum 1; the 260 female moths lived an average of 10.53 days, maximum 20, minimum 1. (Table 70.)

TABLE 70.—*Length of life of 252 male and 260 female codling moths of the second brood in captivity, Cornelia, Ga., 1921*

Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths	Length of life	Number of male moths	Number of female moths
Days			*Days*			*Days*		
1	2	1	10	24	33	19	11	3
2	2	1	11	19	28	20	9	1
3	4	2	12	23	32	21	2	0
4	5	7	13	24	31	22	1	0
5	7	8	14	16	12	23	1	0
6	12	17	15	12	9			
7	10	14	16	9	9	Total	252	260
8	19	23	17	11	5			
9	18	21	18	11	3			

Summary of the second generation.—A summary of results from observations on the separate stages of the second generation of the codling moth shows the average length of the complete life cycle to be 43.83 days, maximum 90, minimum 26. (Table 71.)

TABLE 71.—*Summary of results from experiments on the separate stages of the second generation of the codling moth, Cornelia, Ga., 1921*

Stages of the complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	5.39	7	5
Feeding period of larvae	19.05	36	12
Making of cocoons	6.07	27	1
Pupal stage	11.47	16	7
Time before egg deposition	1.85	4	1
Total	43.83		
Length of life of male moths	11.81	23	1
Length of life of female moths	10.53	20	1

Average number of eggs per female moth, 93.63.

THE THIRD GENERATION

EGGS OF THE THIRD BROOD

Time of deposition.—The deposition of 25,059 eggs of this brood in rearing cages began July 15 and extended more or less regularly over a period of 49 days. The maximum deposition occurred about August 1. (Table 72.)

TABLE 72.—*Time of deposition, length of incubation, and time of hatching of 25,059 eggs of the third brood of the codling moth, Cornelia, Ga., 1921*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
1	53	July 15	July 17	July 20	July 21	44	2	5	6	
2					July 22	9	2	5	7	
3	130	July 16	July 18	July 21	...do	127	2	5	6	
4					July 23	3	2	5	7	
5	44	July 17	July 19	July 22	...do	37	2	5	6	
6					July 24	7	2	5	7	
7	106	July 18	July 20	July 23	...do	88	2	5	6	18
8	161	July 19	July 21	July 24	July 25	60	2	5	6	
9					July 26	91	2	5	7	10
10	68	July 20	July 22	July 25	...do	25	2	5	6	
11					July 27	43	2	5	7	
12	273	July 21	July 23	July 26	...do	268	2	5	6	5
13	130	July 22	July 24	July 27	July 28	130	2	5	6	
14	211	July 23	July 25	July 28	...do	116	2	5	5	
15					July 29	95	2	5	6	
16	767	July 24	July 26	July 28	...do	537	2	4	5	
17					July 30	230	2	4	6	
18	356	July 25	July 27	July 29	...do	199	2	4	5	
19					July 31	157	2	4	6	
20	570	July 26	July 28	July 30	...do	564	2	4	5	
21					Aug. 1	6	2	4	6	
22	764	July 27	July 29	July 30	...do	741	2	3	5	
23					Aug. 2	23	2	3	6	
24	695	July 28	July 30	Aug. 1	...do	681	2	4	5	
25					Aug. 3	14	2	4	6	
26	797	July 29	July 31	Aug. 2	...do	741	2	4	5	
27					Aug. 4	56	2	4	6	
28	654	July 30	Aug. 2	Aug. 3	...do	589	3	4	5	
29					Aug. 5	65	3	4	6	
30	1,712	July 31	Aug. 2	Aug. 4	...do	1,558	2	4	5	
31					Aug. 6	154	2	4	6	

TABLE 72.—*Time of deposition, length of incubation, and time of hatching of 25,059 eggs of the third brood of the codling moth, Cornelia, Ga., 1921*—Contd.

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
32	1,847	Aug. 1	Aug. 3	Aug. 6	Aug. 7	1,736	2	5	6	
33					Aug. 8	111	2	5	7	
34	1,792	Aug. 2	Aug. 4	Aug. 7	do	1,667	2	5	6	
35					Aug. 9	125	2	5	7	
36	938	Aug. 3	Aug. 5	Aug. 8	do	825	2	5	6	
37					Aug. 10	113	2	5	7	
38	940	Aug. 4	Aug. 6	Aug. 9	do	827	2	5	6	
39					Aug. 11	113	2	5	7	
40	640	Aug. 5	Aug. 7	Aug. 10	do	486	2	5	6	
41					Aug. 12	154	2	5	7	
42	890	Aug. 6	Aug. 8	Aug. 11	do	890	2	5	6	
43	788	Aug. 7	Aug. 9	Aug. 12	Aug. 13	780	2	5	6	
44					Aug. 14	8	2	5	7	
45	817	Aug. 8	Aug. 10	Aug. 13	do	817	2	5	6	
46	999	Aug. 9	Aug. 11	Aug. 14	Aug. 15	999	2	5	6	
47	1,013	Aug. 10	Aug. 12	Aug. 15	Aug. 16	507	2	5	6	
48					Aug. 17	506	2	5	7	
49	729	Aug. 11	Aug. 13	Aug. 16	do	729	2	5	6	
50	771	Aug. 12	Aug. 14	Aug. 17	Aug. 18	709	2	5	6	
51					Aug. 19	62	2	5	7	
52	922	Aug. 13	Aug. 15	Aug. 18	do	876	2	5	6	
53					Aug. 20	46	2	5	7	
54	938	Aug. 14	Aug. 16	Aug. 19	do	929	2	5	6	
55					Aug. 21	9	2	5	7	
56	209	Aug. 15	Aug. 17	Aug. 20	do	209	2	5	6	
57	289	Aug. 16	Aug. 18	Aug. 21	Aug. 22	289	2	5	6	
58	519	Aug. 17	Aug. 19	Aug. 22	Aug. 23	327	2	5	6	
59					Aug. 24	192	2	5	7	
60	385	Aug. 18	Aug. 20	Aug. 23	do	323	2	5	6	
61					Aug. 25	62	2	5	7	
62	508	Aug. 19	Aug. 21	Aug. 26	Aug. 27	478	2	7	8	
63					Aug. 28	30	2	7	9	
64	303	Aug. 20	Aug. 22	Aug. 26	Aug. 27	255	2	6	7	
65					Aug. 28	48	2	6	8	
66	244	Aug. 21	Aug. 23	Aug. 28	Aug. 29	234	2	7	8	10
67	19	Aug. 22	Aug. 24	Aug. 29	Aug. 30	19	2	7	8	
68	213	Aug. 23	Aug. 25	do	do	165	2	6	7	
69					Aug. 31	43	2	6	8	5
70	1	Aug. 24	Aug. 26	Aug. 30	do	1	2	6	7	
71	282	Aug. 25	do	Aug. 31	Sept. 1	282	1	6	7	
72	27	Aug. 26	Aug. 28	do	do	21	2	5	6	
73					Sept. 2	6	2	5	7	
74	29	Aug. 27	Aug. 29	Sept. 1	do	27	2	5	6	
75					Sept. 3	2	2	5	7	
76	304	Aug. 28	Aug. 30	Sept. 2	do	304	2	5	6	
77	16	Aug. 29	Aug. 31	do	do	14	2	4	5	2
78	10	Aug. 30	Sept. 1	Sept. 3	Sept. 4	9	2	4	5	
79					Sept. 5	1	2	4	6	
80	81	Aug. 31	Sept. 2	Sept. 4	do	77	2	4	5	
81					Sept. 6	4	2	4	6	
82	64	Sept. 1	Sept. 3	Sept. 5	do	60	2	4	5	
83					Sept. 7	4	2	4	6	
84	41	Sept. 2	Sept. 4	Sept. 6	do	41	2	4	5	
Total	25,059					25,009				50
Average							2	4.80	5.93	

Length of incubation.—The first of the eggs for this brood hatched July 21, which was 6 days after the eggs were deposited. The average length of the incubation period of 25,009 eggs, as shown by Table 72, was 5.93 days, maximum 9, minimum 5. The red ring appeared on an average 2 days after egg deposition, and the black spot 4.8 days after deposition.

LARVAE OF THE THIRD BROOD

Time of hatching.—Third-brood larvae commenced to hatch on July 21, as shown by Table 72, and continued to hatch until September 7. The maximum hatching occurred on August 8. The hatching period extended over 49 days.

Length of the feeding period.—Table 73 gives a variation of from 12 to 38 days in the feeding period of 850 larvae, with an average period of 20.37 days. The first larvae entered the fruit July 21, the last September 7.

TABLE 73.—*Length of feeding period of 850 larvae of the third brood of the codling moth, Cornelia, Ga., 1921*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																								
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	38
July 21	16			2	1	1		1	3	4			2		2											
July 22	33				1	6	7	6	7	4	1	1														
July 23	8				1	2	1		2		2															
July 24	1						1																			
July 25	12						1	2	2	1	2	1	1	2												
July 26	8				1	1	3			1			1	1												
July 27	36		1	1		2	6	9	2	6	3	3	1					1			1					
July 28	44	1				2	6	4	3	4	8	3		5	4	1			1		2					
July 29	27					2	3	5	12		3		1	1												
July 30	47				1		1	11	9	8	5	5	4		1							1			1	
July 31	55						1	8	7	8	10	6	2	1	3	3		1	1	1		1	1		1	
Aug. 1	27							2	6	3	3	4	1	3	2			2								1
Aug. 2	18								7		4	2			3		2									
Aug. 3	23						2	3	4	3	1	2	2	2		2		1	1							
Aug. 4	14										2	1	3	1	1	2			1		1		1	1		
Aug. 5	30					1	1	5	5	4	3	3	3	2		1					1		1			
Aug. 6	27					2	3	1	2	5	2	3	2	4	1		1					1				
Aug. 7	26							4	6	7	5		3	1												
Aug. 8	15					1	2	4	1	3	3	1														
Aug. 9	29						2		7		6	5	3	4			1		1							
Aug. 10	12					1			1	3	1	1	1	3	1											
Aug. 11	24					1		1	3	8	6	1	3					1								
Aug. 12	24								1	8	6	1	4	1	1			1			1					
Aug. 13	30							3	7	5	9	4	2													
Aug. 14	12							1	3	2	4		1		1											
Aug. 15	9						1	2	3	1	1			1												
Aug. 16	20						3	4	4	4	3		1				1									
Aug. 17	7						1	1	1	2	1	1														
Aug. 18	9							2	2	1		2	1	1												
Aug. 19	15						3	4	3			2		1	1			1								
Aug. 20	14							2	1	3	1	4		1	1		1									
Aug. 21	10						2		2	1	2	2	1													
Aug. 22	4					1	1	2																		
Aug. 23	5										1	1	1		1						1					
Aug. 24	20					1	2	1	3	5	6		2													
Aug. 25	17					1		2	2	4	3		2	3												
Aug. 26	5						1		1	1		1		1												
Aug. 27	5					1		2			1		1													
Aug. 28	28					3	7	7	4	4	2				1											
Aug. 29	33				3	4	1	4	5	4	3	3	1	2				2	1							
Aug. 30	1											1														
Aug. 31	5				2	1		1	1																	
Sept. 1	11				2	2	4	1					1	1												
Sept. 2	5					1	3		1																	
Sept. 3	2									1			1													
Sept. 4	4					1	1	1			1															
Sept. 6	13					2	3	2	3	1		1				1										
Sept. 7	10					2	1	2	1	1	1	2														
Total	850	1	1	3	12	42	74	110	137	120	115	67	52	42	24	10	6	10	6	1	7	3	3	1	1	1

Length of the cocooning period.—Table 74 shows the cocooning period of 42 individuals. The average length of the cocooning period was 6.12 days, maximum 10, minimum 3.

TABLE 74.—*Length of cocooning period of 42 transforming larvae of the third brood of the codling moth, Cornelia, Ga., 1921*

Larvae left fruit	Number of individuals	Number of individuals having cocooning periods [1] of specified number of days								Average	Maximum	Minimum
		3	4	5	6	7	8	9	10			
										Days	*Days*	*Days*
Aug. 4	1					1				7.00	7	7
Aug. 5	1			1						5.00	5	5
Aug. 6	1						1			8.00	8	8
Aug. 7	1			1						5.00	5	5
Aug. 8	3		1	1		1				5.33	7	4
Aug. 9	1			1						5.00	5	5
Aug. 10	3			2				1		6.33	9	5
Aug. 11	2						1		1	9.00	10	8
Aug. 12	2		2							4.00	4	4
Aug. 13	3			1		1	1			6.66	8	5
Aug. 14	2			1	1					5.50	6	5
Aug. 15	2				1		1			7.00	8	6
Aug. 16	4		1	1	1		1			5.75	8	4
Aug. 17	3	1		1	1					4.66	6	3
Aug. 18	3		1	1	1					5.00	6	4
Aug. 19	1							1		9.00	9	9
Aug. 20	1				1					6.00	6	6
Aug. 21	3				1		1	1		7.66	9	6
Aug. 24	1				1					6.00	6	6
Aug. 26	1				1					6.00	6	6
Sept. 12	1		1							4.00	4	4
Sept. 13	1							1		9.00	9	9
Sept. 14	1				1					6.00	6	6
Total or average	42	1	6	11	10	3	6	4	1	6.12		

[1] Time from leaving the fruit to the time of pupation.

Percentage of transforming and wintering larvae.—Of the 850 larvae, only 42, or 4.94 per cent changed to pupae. This leaves 95.06 per cent wintering.

PUPAE OF THE THIRD BROOD

Time of pupation.—The earliest pupation of the third brood occurred August 10, the last September 22. The number of individuals under observation was 42. (Table 75.)

TABLE 75.—*Time of pupation of 42 transforming larvae of the third brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae	Date of pupation	Number of pupae
Aug. 10	1	Aug. 18	1	Aug. 26	1	Sept. 20	1
Aug. 11	1	Aug. 19	3	Aug. 27	1	Sept. 22	1
Aug. 12	2	Aug. 20	4	Aug. 28	1		
Aug. 13	1	Aug. 21	4	Aug. 29	1	Total	42
Aug. 14	2	Aug. 22	3	Aug. 30	2		
Aug. 15	3	Aug. 23	3	Sept. 1	1		
Aug. 16	2	Aug. 24	2	Sept. 16	1		

Length of the pupal stage.—The average length of the pupal stage of 38 pupae of the third brood was 11.03 days, maximum 14, minimum 8. (Table 76.)

TABLE 76.—*Length of the pupal stage of 38 pupae of the third brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days							Date of pupation	Number of individuals	Number of individuals having pupal stages of specified number of days						
		8	9	10	11	12	13	14			8	9	10	11	12	13	14
Aug. 10	1			1					Aug. 23	3	1		2				
Aug. 11	1		1						Aug. 24	2		1		1			
Aug. 12	2			1		1			Aug. 26	1		1					
Aug. 13	1						1		Aug. 27	1			1				
Aug. 14	1	1							Aug. 29	1		1					
Aug. 15	3			1	1	1			Aug. 30	2	2						
Aug. 16	1					1			Sept. 1	1			1				
Aug. 18	1					1			Sept. 16	1				1			
Aug. 19	3					2		1	Sept. 20	1					1		
Aug. 20	3					1	2		Sept. 22	1				1			
Aug. 21	4					1	2	1									
Aug. 22	3					3			Total	38	4	4	7	4	12	5	2

MOTHS OF THE THIRD BROOD

Time of emergence.—The time of emergence of 38 moths is presented in Table 77. The first of these moths issued August 20, the last October 3. These moths were from insectary-reared material.

TABLE 77.—*Time of emergence of 38 codling moths of the third brood, from material reared at the insectary, Cornelia, Ga., 1921*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
Aug. 20	2	Aug. 27	1	Sept. 2	5	Sept. 11	1
Aug. 22	2	Aug. 28	1	Sept. 3	5	Sept. 27	1
Aug. 24	1	Aug. 30	1	Sept. 4	4	Oct. 2	1
Aug. 25	1	Aug. 31	2	Sept. 6	2	Oct. 3	1
Aug. 26	2	Sept. 1	1	Sept. 7	4	Total	38

Time of oviposition.—Egg deposition commenced from 2 to 3 days after the time of emergence of the moths and generally extended over a period of from 5 to 10 days. The first eggs were deposited August 21, and deposition continued until September 21.

Number of eggs per female moth.—The data presented in Table 79 include the records of 16 female moths which were confined with 9 male moths in cage 1. These moths produced a total of 1,020 eggs, or an average of 63.75 per female moth. This average is not accurate, owing to the fact that ants entered the cage and destroyed a number of moths.

Length of life of moths.—Moths of this brood were all placed in the same cage for the purpose of obtaining fourth-brood eggs; hence no record was made on the length of life of each individual moth.

Summary of the third generation.—A summary of results from observations on the separate stages of the third generation of the codling moth shows the average length of the complete life cycle to be 45.95 days. (Table 78.)

TABLE 78.—*Summary of results from experiments on the separate stages of the third generation of the codling moth, Cornelia, Ga., 1921*

Stages of the complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	5.93	9	5
Feeding period of larvae	20.37	38	12
Making of cocoons	6.12	10	3
Pupal stage	11.03	14	8
Time before egg deposition	2.50	9	1
Total	45.95		

THE FOURTH GENERATION

EGGS OF THE FOURTH BROOD

Time of deposition.—Deposition of the fourth brood of eggs began on August 21 and ended September 21. The deposition period was short, covering 32 days. The maximum deposition occurred on September 14; on this date 188 eggs were deposited. A total of 1,020 eggs were observed. (Table 79.)

TABLE 79.—*Time of deposition, length of incubation, and time of hatching of 1,020 eggs of the fourth brood of the codling moth, Cornelia, Ga., 1921*

Observation No.	Number of eggs	Date				Number of eggs hatched	Length of time before appearance of—		Incubation period	Number of eggs failed to hatch
		Deposited	Red ring appeared	Black spot appeared	Hatched		Red ring	Black spot		
							Days	*Days*	*Days*	
1	18	Aug. 21	Aug. 23	Aug. 29	Aug. 30	18	2	8	9	
2	37	Aug. 25	Aug. 27	Aug. 31	Sept. 1	37	2	6	7	
3	41	Aug. 26	Aug. 28	...do...	...do...	41	2	5	6	
4	75	Aug. 28	Aug. 30	Sept. 2	Sept. 3	75	2	5	6	
5	52	Aug. 29	Aug. 31	...do...	...do...	52	2	4	5	
6	11	Aug. 30	Sept. 1	Sept. 3	Sept. 4	11	2	4	5	
7	25	Sept. 5	Sept. 7	Sept. 9	Sept. 10	3	2	4	5	
8		...do...			Sept. 11	22	2	4	6	
9	53	Sept. 6	Sept. 8	Sept. 11	Sept. 12	53	2	5	6	
10	8	Sept. 7	Sept. 9	Sept. 12	Sept. 13	7	2	5	6	1
11	46	Sept. 8	Sept. 10	Sept. 13	Sept. 14	46	2	5	6	
12	15	Sept. 9	Sept. 11	Sept. 14	Sept. 15	15	2	5	6	
13	41	Sept. 10	Sept. 12	Sept. 15	Sept. 16	41	2	5	6	
14	19	Sept. 11	Sept. 13	...do...	...do...	14	2	4	5	
15					Sept. 17	1	2	4	6	4
16	63	Sept. 12	Sept. 14	Sept. 16	...do...	63	2	4	5	
17	185	Sept. 13	Sept. 15	Sept. 17	Sept. 18	142	2	4	5	
18					Sept. 19	43	2	4	6	
19	188	Sept. 14	Sept. 16	Sept. 18	...do...	158	2	4	5	
20					Sept. 20	30	2	4	6	
21	50	Sept. 15	Sept. 17	Sept. 19	...do...	43	2	4	5	
22					Sept. 21	7	2	4	6	
23	24	Sept. 16	Sept. 18	Sept. 20	...do...	4	2	4	5	
24					Sept. 22	20	2	4	6	
25	35	Sept. 17	Sept. 19	Sept. 22	Sept. 23	35	2	5	6	
26	7	Sept. 18	Sept. 20	Sept. 23	Sept. 24	7	2	5	6	
27	10	Sept. 19	Sept. 21	Sept. 24	Sept. 25	6	2	5	6	
28					Sept. 26	2	2	5	7	2
29	10	Sept. 20	Sept. 22	Sept. 25	...do...	5	2	5	6	5
30	7	Sept. 21	Sept. 23							7
Total	1,020					1,001				19
Average							2	4.48	5.60	

Length of incubation.—The first of the larvae hatched 9 days after the eggs were deposited. The average length of the incubation period of 1,001 eggs, as shown by Table 79, was 5.6 days, maximum 9, minimum 5.

LARVAE OF THE FOURTH BROOD

Time of hatching.—Fourth-brood larvae commenced to hatch on August 30; the last hatched on September 26, and the maximum number on September 19. (Table 79.)

Length of the feeding period.—Table 80 shows a range in the feeding period of 217 fourth-brood larvae of from 12 to 43 days, with an average period of 25.12 days.

TABLE 80.—*Length of feeding period of 217 larvae of the fourth brood of the codling moth, Cornelia, Ga., 1921*

Date of entering fruit	Number of individuals	Number of larvae feeding specified number of days																																
		12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	43
Aug. 30	10			5	1		1	2		1																						
Sept. 1	19	1		1		3	7	2	1	1	1				1	1																
Sept. 2	8					1	2		3	1		1																				
Sept. 3	19				3	8	3	2		1			2																			
Sept. 4	2												1		1																	
Sept. 10	1		1																													
Sept. 11	16				1	1	2	1	2		2	3		1		1										1					1	
Sept. 12	24						5		2	2	2	3	2		2	1		1			1					2					1
Sept. 13	2									1		1																				
Sept. 14	18						1	2		2	4	4	1		1			1	1			1										
Sept. 15	8							2			1	1			1		1				1					1						
Sept. 16	12												1		2	1		1	1	1			1	1	1		1	1				
Sept. 17	13												1				2	2	1	4			1		1		1					
Sept. 18	4																		1	1			1	1								
Sept. 19	30										1	1	1				1	3	4	2	1	4	3	2	3			2	1	1		
Sept. 20	14																	1		2		2	2	2	1	3		1				
Sept. 21	2																						1		1							
Sept. 22	8																1			1		1	2		1		1	1				
Sept. 23	6																					2	3	1								
Sept. 24	1																								1							
Total	217	1	1	6	5	13	21	11	8	9	11	14	9	1	7	4	6	9	8	11	3	10	14	7	9	6	3	5	2	1	1	1

Length of the cocooning period.—Observations with reference to the length of the cocooning period of larvae of this generation were limited to eight individuals. The average length of this period was 13 days, maximum 20, minimum 4. (Table 81.)

TABLE 81.—*Length of cocooning period of 8 transforming larvae of the fourth brood of the codling moth, Cornelia, Ga., 1921*

Larvae left fruit	Number of individuals	Number of individuals having cocooning periods [1] of specified number of days						Average	Maximum	Minimum
		4	11	13	16	18	20			
								Days	*Days*	*Days*
Sept. 16	1	1						4.00	4	4
Sept. 17	1	1						4.00	4	4
Sept. 27	1		1					11.00	11	11
Sept. 29	2			1		1		15.50	18	13
Oct. 2	1						1	20.00	20	20
Oct. 3	2				1	1		17.00	18	16
Total or average	8	2	1	1	1	2	1	13.00		

[1] Time from leaving the fruit to the time of pupation.

Percentage of transforming and wintering larvae.—Of the 217 larvae, only 8, or 3.69 per cent, transformed to pupae. This leaves 96.31 per cent wintering.

PUPAE OF THE FOURTH BROOD

Time of pupation.—It will be observed from Table 82 that pupation of the fourth brood occurred from September 20 to October 22.

TABLE 82.—*Time of pupation of 8 transforming larvae of the fourth brood of the codling moth, Cornelia, Ga., 1921*

Date of pupation	Number of pupae	Date of pupation	Number of pupae
Sept. 20	1	Oct. 19	1
Sept. 21	1	Oct. 21	1
Oct. 8	1	Oct. 22	1
Oct. 12	1		
Oct. 17	1	Total	8

Length of the pupal stage.—Two moths emerged from the pupae of this brood. One individual pupated September 20 and emerged October 5, making a total of 15 days spent in the pupal stage. The other individual pupated September 21 and emerged October 8, spending 17 days in the pupal stage. The writer was transferred to New Orleans late in October, and therefore observations on the length of the pupal stage were discontinued.

MOTHS OF THE FOURTH BROOD

Length of life of moths.—The length of life of the fourth-brood moths was not obtained, nor had all moths emerged before the writer was transferred. It is believed, however, that if the moths had been observed for oviposition records, a fifth brood would have been recorded, and that the eggs would have hatched about the time the late variety of apples were being harvested. Only a few fourth-brood larvae transformed in the insectary. It is probable that hundreds transformed in the field, where the number of individuals was greater.

Summary of the fourth generation.—A summary of results from observations on the first three stages of the fourth generation of the codling moth is presented in Table 83. No eggs for this brood were recorded.

TABLE 83.—*Summary of results from experiments on the separate stages of the fourth generation of the codling moth, Cornelia, Ga., 1921*

Stages of the complete life cycle	Number of days		
	Average	Maximum	Minimum
Incubation of eggs	5.60	9	5
Feeding period of larvae	25.12	43	12
Making of cocoons	13.00	20	4

BAND-RECORD EXPERIMENTS OF 1921

During 1921 the band-record tests were extended to two orchards, one at Cornelia, and one at View, Ga. The purpose of these tests in the widely separated orchards was to determine the possible existence of differences in the time of development of the codling moth.

Tables 85 and 87 show that there is practically no difference in the time of the appearance of the first larvae and the maximum appearance of the larvae for each brood in the two localities studied. The data also check up well with the insectary material. The following band-record tables do not show the appearance of the later broods, owing to the fact that the ravages of the early broods destroyed most of the apples early in the season. The tables do not give the percentages of moths and parasites emerging in 1922, nor the percentages of wintering and dead larvae, because the band-record studies were discontinued in the fall of 1921.

THE CORNELIA ORCHARD

A total of 4,674 larvae were collected in the Cornelia orchard during the season from eight trees of a late fall variety. The first larvae appeared beneath the bands May 26, and the last October 2. (Table 84 and fig. 17.)

TABLE 84.—*Data of 4,674 codling-moth larvae collected from bands at Cornelia, Ga., 1921*

Date of collection, 1921	Collection No.	Larvae collected	Moths emerging, 1921	Parasites emerging, 1921	Moths emerging, 1921	Parasites emerging, 1921
		Number	*Number*	*Number*	*Per cent*	*Per cent*
May 26	1	1	1	----------	100.00	----------
May 29	2	5	4	----------	80.00	----------
June 1	3	18	13	----------	72.22	----------
June 4	4	91	44	16	48.35	17.58
June 7	5	107	35	23	32.71	21.49
June 10	6	139	78	18	56.11	12.95
June 13	7	182	95	9	52.20	4.94
June 16	8	285	176	11	61.75	3.86
June 19	9	250	116	13	46.40	5.20
June 22	10	251	128	22	51.00	8.76
June 25	11	289	152	17	52.60	5.88
June 28	12	250	153	15	61.20	6.00
July 1	13	291	158	10	54.29	3.44
July 4	14	199	109	6	54.77	3.01
July 7	15	212	117	15	55.19	7.08
July 10	16	227	121	34	53.30	14.98
July 13	17	254	102	21	40.16	8.27
July 16	18	237	88	21	37.13	8.86
July 19	19	156	59	12	37.82	7.69
July 22	20	173	61	25	35.26	14.45
July 25	21	91	27	11	29.67	12.09
July 28	22	84	21	12	25.00	14.29
July 31	23	99	29	16	29.29	16.16
Aug. 3	24	114	13	5	11.40	4.39
Aug. 6	25	87	9	11	10.34	12.64
Aug. 9	26	83	10	8	12.05	9.64
Aug. 12	27	75	5	4	6.67	5.33
Aug. 15	28	67	4	1	5.97	1.49
Aug. 18	29	60	1	----------	1.67	----------
Aug. 21	30	29	----------	----------	----------	----------
Aug. 24	31	41	----------	1	----------	2.44
Aug. 27	32	31	----------	----------	----------	----------
Aug. 30	33	34	----------	----------	----------	----------
Sept. 2	34	35	----------	2	----------	5.71
Sept. 5	35	33	----------	----------	----------	----------
Sept. 8	36	28	----------	----------	----------	----------
Sept. 11	37	14	----------	----------	----------	----------
Sept. 14	38	10	----------	----------	----------	----------
Sept. 17	39	6	----------	----------	----------	----------
Sept. 20	40	9	----------	----------	----------	----------
Sept. 23	41	12	----------	----------	----------	----------
Sept. 26	42	4	----------	----------	----------	----------
Sept. 29	43	9	----------	----------	----------	----------
Oct. 2	44	2	----------	----------	----------	----------
Total	----------	4,674	1,929	359	----------	----------
Average	----------	----------	----------	----------	41.27	7.68

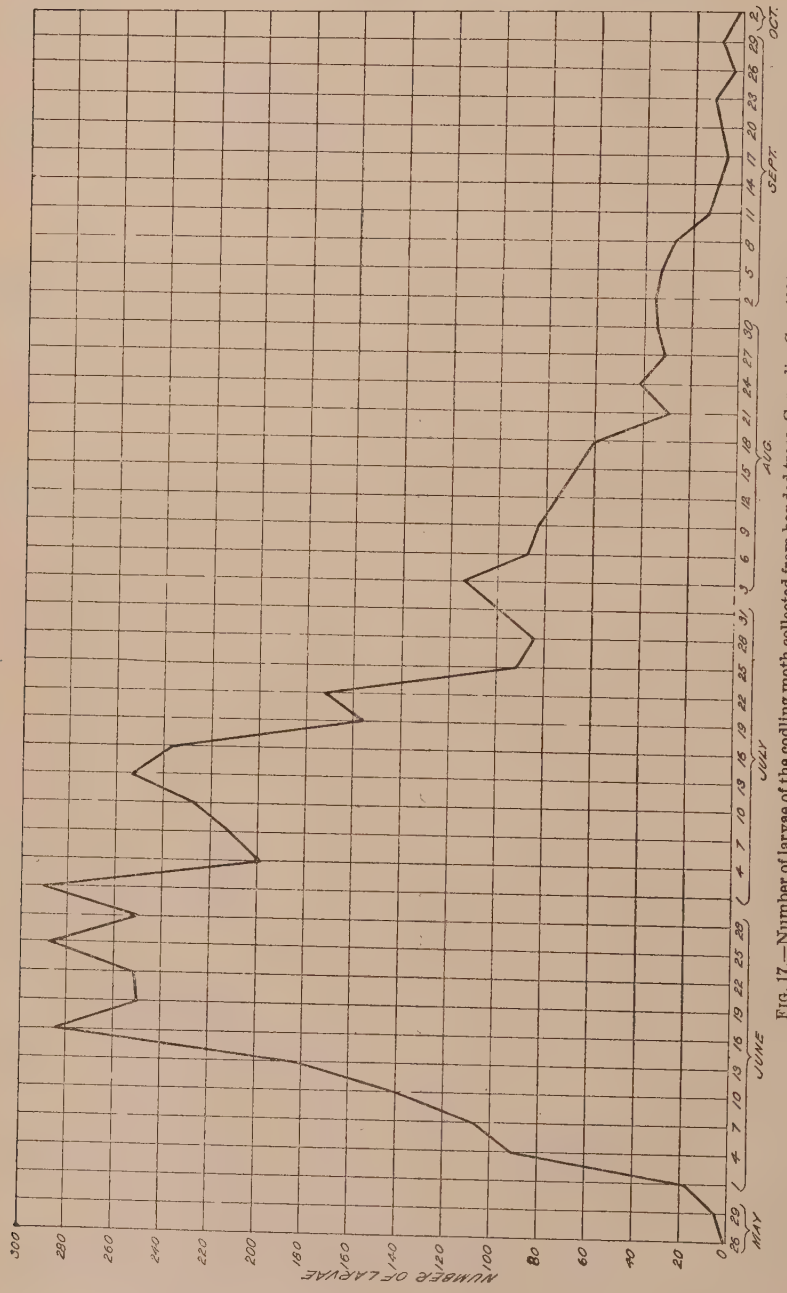

FIG. 17.—Number of larvae of the codling moth collected from banded trees, Cornelia, Ga., 1921

Emergence of moths.—The first moth emerged on June 8. (Table 85 and fig. 18.) No record is made of the moths and parasites which emerged from these collections in 1922, because the work was discontinued in the fall of 1921.

TABLE 85.—*Emergence of 1,937 codling moths from band-record material collected at Cornelia, Ga., 1921*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 8	1	July 2	48	July 23	31	Aug. 13	9
June 12	1	July 3	62	July 24	33	Aug. 14	8
June 13	2	July 4	66	July 25	27	Aug. 15	4
June 14	2	July 5	54	July 26	41	Aug. 17	4
June 15	10	July 6	39	July 27	52	Aug. 18	7
June 16	5	July 7	30	July 28	37	Aug. 19	1
June 17	13	July 8	81	July 29	45	Aug. 20	6
June 18	16	July 9	49	July 30	33	Aug. 21	4
June 19	20	July 10	91	July 31	31	Aug. 22	4
June 20	4	July 11	24	Aug. 1	24	Aug. 23	2
June 21	6	July 12	22	Aug. 2	33	Aug. 25	3
June 22	18	July 13	31	Aug. 3	22	Aug. 26	4
June 23	36	July 14	62	Aug. 4	27	Aug. 27	3
June 24	29	July 15	34	Aug. 5	6	Aug. 28	2
June 25	6	July 16	43	Aug. 6	14	Aug. 29	1
June 26	27	July 17	37	Aug. 7	13	Aug. 30	2
June 27	31	July 18	26	Aug. 8	10	Sept. 1	1
June 28	36	July 19	28	Aug. 9	8	Sept. 2	1
June 29	60	July 20	28	Aug. 10	11	Sept. 5	2
June 30	69	July 21	44	Aug. 11	6		
July 1	30	July 22	33	Aug. 12	11	Total	1,937

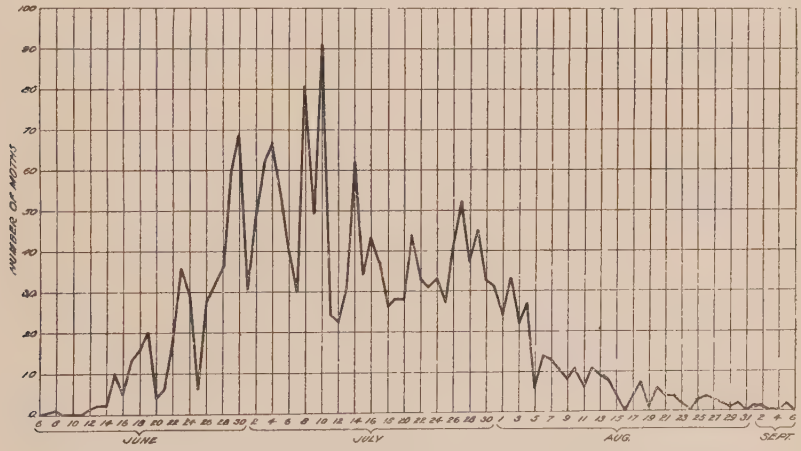

FIG. 18.—Time of emergence of codling moths from band-collected material, Cornelia, Ga., 1921

ORCHARD AT VIEW

The orchard is located one-fourth mile north of View and 8 miles southwest of Cornelia. Sixteen trees were used in this experiment, all of a late fall variety. Table 86 shows that 3,105 larvae were collected during the season. The first collection was made May 26 and the last October 8. (Fig. 19.) The first moth emerged June 7 and the last on August 29. (Table 87 and fig. 20.)

TABLE 86.—*Data of 3,105 codling-moth larvae collected from bands at View, Ga., 1921*

Date of collection, 1921	Collection No.	Larvae collected	Moths emerging, 1921	Parasites emerging, 1921	Moths emerging, 1921	Parasites emerging, 1921
		Number	*Number*	*Number*	*Per cent*	*Per cent*
May 26	1	1				
May 29	2	5	3		60.00	
June 1	3	25	10	2	40.00	8.00
June 4	4	34	18	12	52.94	35.29
June 7	5	90	51	8	56.67	8.89
June 10	6	78	55	10	70.51	12.82
June 13	7	55	21		38.18	
June 16	8	102	53	8	51.96	7.84
June 19	9	167	91	8	54.49	4.79
June 22	10	127	60	5	47.24	3.94
June 25	11	151	83	4	54.97	2.65
June 28	12	205	94	3	45.85	1.46
July 1	13	278	105	16	37.77	5.76
July 4	14	210	102	10	48.57	4.76
July 7	15	147	69	4	46.94	2.72
July 10	16	92	31	2	33.70	2.17
July 13	17	64	28	3	43.75	4.69
July 16	18	61	30	4	49.18	6.56
July 19	19	58	18		31.03	
July 22	20	68	13	2	19.12	2.94
July 25	21	47	17	1	36.17	2.13
July 28	22	41	8	2	19.51	4.88
July 31	23	59	17	2	28.81	3.39
Aug. 3	24	165	26	5	15.76	3.03
Aug. 6	25	148	3	3	2.03	2.03
Aug. 9	26	88	3	2	3.41	2.27
Aug. 12	27	111		1		.90
Aug. 15	28	77	1		1.30	
Aug. 18	29	62		1		1.61
Aug. 21	30	45				
Aug. 24	31	45				
Aug. 27	32	19				
Aug. 30	33	24				
Sept. 2	34	19				
Sept. 5	35	26				
Sept. 8	36	31				
Sept. 11	37	20				
Sept. 14	38	22				
Sept. 17	39	11				
Sept. 20	40	13				
Sept. 23	41	7				
Sept. 29	42	3				
Oct. 5	43	3				
Oct. 8	44	1				
Total		3,105	1,010	118		
Average					32.53	3.80

TABLE 87.—*Emergence of 1,009 codling moths from band-record material collected at View, Ga., 1921*

Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths	Date of emergence	Number of moths
June 7	1	June 30	20	July 19	24	Aug. 7	8
June 12	1	July 1	30	July 20	13	Aug. 8	1
June 13	2	July 2	34	July 21	15	Aug. 10	6
June 14	2	July 3	28	July 22	22	Aug. 11	2
June 15	2	July 4	36	July 23	17	Aug. 12	2
June 16	4	July 5	18	July 24	18	Aug. 13	6
June 17	3	July 6	27	July 25	13	Aug. 14	3
June 18	7	July 7	27	July 26	13	Aug. 15	3
June 19	8	July 8	17	July 27	13	Aug. 16	13
June 20	1	July 9	20	July 28	11	Aug. 18	3
June 21	15	July 10	43	July 29	9	Aug. 19	5
June 22	22	July 11	23	July 30	17	Aug. 20	4
June 23	33	July 12	35	July 31	5	Aug. 21	5
June 24	16	July 13	19	Aug. 1	9	Aug. 22	1
June 25	13	July 14	38	Aug. 2	7	Aug. 23	1
June 26	7	July 15	20	Aug. 3	7	Aug. 29	1
June 27	12	July 16	26	Aug. 4	5		
June 28	11	July 17	33	Aug. 5	3	Total	1,009
June 29	26	July 18	30	Aug. 6	9		

NATURAL ENEMIES OF THE CODLING MOTH

Tenebroides corticalis (Melsh), family Trogosilidae, was found to constitute one of the most important predatory insect enemies of the codling moth in northern Georgia. The adult is small, 7⅝ millimeters in length. It was observed to capture the full-grown larvae and also to break down the cocoon and the codling moth.

FIG. 19.—Number of larvae of the codling moth collected from banded trees, View, Ga., 1921

The larvae of a lace-wing fly were often observed in the act of destroying the contents of the eggs of the codling moth. One larva was able to destroy as many as 50 eggs. The larvae were a source of great annoyance in the insectary.

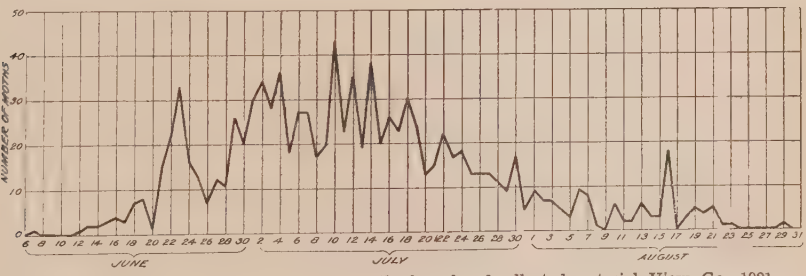

FIG. 20.—Time of emergence of codling moths from band-collected material, View, Ga., 1921

Many spiders were observed feeding on the full-grown larvae beneath the burlap bands on the trees. Ants, also, were observed on many occasions feeding on the larvae of the codling moth.

Parasites played an important part in destroying the codling moth in northern Georgia. The Cornelia band records show that of the 1,596 larvae collected in 1920, 494 died from handling or natural causes,

and that from the remaining 1,102 larvae 990 moths and 112 parasites emerged; that is, 10.16 per cent of those 1,102 larvae were parasitized. The parasites collected were determined as *Exorista achracea* (Van der Wulp) and *Ascogaster carpocapsae* Vier.

MISCELLANEOUS STUDIES

OBSERVATIONS ON COPULATION AND OVIPOSITION OF CODLING MOTHS OF THE SPRING BROOD, 1920

Observations on the time of copulation of the codling moths and the fecundity of individual moths are given in Table 88. The majority of the moths were observed in copula between 7 and 9 p. m. or about dusk. The average number of eggs deposited per female moth was 7,733. The average time spent in copulation was 2 hours and 18 minutes.

TABLE 88.—*Data of observations on the copulatory period and oviposition of 43 pairs of codling moths of the spring brood, Cornelia, Ga., 1920*

Pair No.	Date moths emerged	Date found in copula	Time of last observation prior to copulation	Time found in copula	Time of last observation prior to separation	Moths separated prior to—	Minimum time attached		Date of—			Length of period				Total length of life of female moth	Number of days on which oviposition occurred	Eggs deposited	Average eggs per oviposition	Maximum eggs deposited in one day
									First oviposition	Last oviposition	Death of female moth	Before oviposition	Of oviposition	From emergence to last oviposition	Of life of female after oviposition					
							Hrs.	*Min.*				*Days*	*Days*	*Days*	*Days*	*Days*		*No.*	*No.*	*No.*
1	May 6	May 17	5.00 p. m.	6.00 p. m.	----------	6.10 p. m.	------	------	May 20	May 28	May 29	14	9	22	1	23	8	191	23.9	52
2	---do-----	May 16	7.00 p. m.	9.00 p. m.	9.45 p. m.	10.00 p. m.	------	45	May 17	May 18	May 23	11	2	12	5	17	2	6	3.0	5
3	May 7	May 18	7.30 p. m.	7.40 p. m.	8.45 p. m.	9.00 p. m.	1	5	----------	----------	June 2	----------	----------	----------	----------	26	----------	----------	----------	0
4	---do-----	May 20	8.00 p. m.	8.15 p. m.	9.15 p. m.	9.30 p. m.	1	------	May 22	May 22	May 24	15	1	15	2	17	1	20	20.0	20
5	---do-----	May 13	8.45 p. m.	8.50 p. m.	9.00 p. m.	9.15 p. m.	------	10	May 19	May 23	May 29	12	5	16	6	22	5	108	21.6	46
6	---do-----	May 14	7.00 p. m.	7.15 p. m.	8.00 p. m.	8.15 p. m.	------	45	May 16	May 27	---do-----	9	12	20	2	22	8	126	15.7	39
7	May 8	---do-----	7.00 p. m.	7.15 p. m.	8.30 p. m.	8.40 p. m.	1	15	May 19	May 28	June 2	11	10	20	5	25	6	123	21.3	45
8	---do-----	---do-----	----------	7.20 p. m.	8.00 p. m.	8.15 p.m.	------	40	----------	----------	May 23	----------	----------	----------	----------	15	----------	----------	----------	0
9	---do-----	---do ----	7.00 p. m.	7.15 p. m.	11.00 p. m.	[1] 6.00 a. m.	3	45	May 22	May 22	---do-----	14	1	14	1	15	1	10	10.0	10
10	---do-----	May 13	----------	11.05 a. m.	9.15 p. m.	9.30 p. m.	10	10	May 14	May 27	June 1	6	14	19	5	24	8	113	14.1	39
11	May 9	May 20	8.00 p. m.	8.15 p. m.	8.30 p. m.	8.45 p. m.	------	15	May 22	May 22	May 27	13	1	13	5	18	1	6	6.0	6
12	---do-----	---do-----	8.00 p. m.	8.15 p. m.	9.15 p. m.	9.30 p. m.	1	------	May 21	May 23	May 24	12	3	14	1	15	3	53	17.6	30
13	---do-----	May 13	8.45 p. m.	8.50 p. m.	12.00 m.n.	12.15 a. m.	3	10	May 16	May 22	May 23	7	7	13	1	14	5	112	22.4	71
14	May 10	May 20	8.00 p. m.	8.15 p. m.	8.30 p. m.	8.45 p. m.	------	15	May 21	May 29	May 29	11	9	19	0	19	6	138	23.0	61
15	---do-----	May 13	----------	11.15 a. m.	8.15 p. m.	8.30 p. m.	9	------	May 14	May 21	May 21	4	8	11	0	11	4	103	25.7	48
16	---do-----	---do-----	8.45 p. m.	8.50 p. m.	9.45 p. m.	10.00 p. m.	------	55	---do-----	May 27	May 28	4	14	17	1	18	9	120	13.3	25
17	---do-----	---do-----	----------	11.20 p. m.	4.30 p. m.	4.45 p. m.	5	10	---do-----	May 30	June 4	4	17	20	5	25	13	219	16.8	56
18	---do-----	---do-----	8.45 p. m.	8.50 p. m.	9 60 p. m.	9.15 p. m.	------	10	May 19	May 27	May 27	9	9	17	0	17	7	128	18.3	36
19	---do ----	May 14	6.45 p. m.	7.00 p. m.	8.00 p. m.	8.15 p. m.	1	------	---do-----	May 29	May 29	9	11	19	0	19	9	184	20.4	38
20	May 11	May 19	6.00 p. m.	7.00 p. m.	7.15 p. m.	7.20 p. m.	------	15	May 20	May 22	May 23	9	3	11	1	12	2	84	42.0	47
21	---do-----	May 14	6.45 p. m.	7.00 p. m.	10.00 p. m.	10.15 p. m.	3	------	May 23	June 3	June 5	12	12	23	2	25	7	66	9.4	16
22	---do-----	---do-----	6.45 p. m.	7.00 p. m.	7.45 p. m.	8.00 a. m.	------	45	May 19	May 21	May 27	8	3	10	6	16	3	51	17.0	23
23	May 12	May 19	8.15 p. m.	8.30 p. m.	8.45 p. m.	8.50 p. m.	------	15	June 20	June 12	June 13	8	24	31	1	32	13	126	9.7	31
24	---do-----	May 20	8.00 p. m.	8.15 p. m.	10.00 p. m.	[1] 6.00 a. m.	1	45	May 21	May 27	June 3	9	7	15	7	22	6	150	25.0	53
25	---do-----	May 18	8.15 p. m.	8.30 p. m.	11.00 a. m.	12.00 m. n.	2	30	May 20	May 23	June 1	8	4	11	9	20	3	38	12.6	21
26	---do-----	May 19	----------	6.00 p. m.	8.00 p. m.	10.00 p. m.	2	------	---do-----	May 20	May 22	8	1	8	2	10	1	56	56.0	56
27	---do-----	May 18	8.15 p. m.	8.30 p. m.	8.45 p. m.	8.50 p. m.	------	15	----------	----------	May 18[2]	----------	----------	----------	----------	[2] 6	----------	----------	----------	0
28	---do-----	May 19	----------	7.10 p. m.	9.15 p. m.	9.30 p. m.	2	5	May 20	June 2	June 3	8	14	21	1	22	10	130	13.0	34
29	---do-----	May 14	6.45 p. m.	7.00 p. m.	[1] 3.00 p. m.	3.38 p. m.	20	------	---do-----	May 28	---do-----	8	9	16	6	22	6	53	8.8	21
30	May 13	---do-----	6.45 p. m.	7.00 p. m.	8.00 p. m.	8.15 p. m.	1	------	----------	----------	June 10	----------	----------	----------	----------	28	----------	----------	----------	0
31	---do-----	May 18	8.00 p. m.	8.30 p. m.	8.45 p. m.	8.50 p. m.	------	15	May 20	May 21	June 5	7	2	8	15	23	2	58	29.0	33
32	---do-----	---do-----	8.15 p. m.	8.30 p. m.	[1] 11.00 a. m.	12.00 m. n.	14	30	---do-----	May 27	June 1	7	8	14	5	19	4	84	21.0	34

[1] On day following date of previous observation.

[2] Moth escaped.

TABLE 88.—*Data of observations on the copulatory period and oviposition of 43 pairs of codling moths of the spring brood, Cornelia, Ga., 1920*—Continued

Pair No.	Date moths emerged	Date found in copula	Time of last observation prior to copulation	Time found in copula	Time of last observation prior to separation	Moths separated prior to—	Minimum time attached		Date of—			Length of period				Total length of life of female moth	Number of days on which oviposition occurred	Eggs deposited	Average eggs per oviposition	Maximum eggs deposited in one day
									First oviposition	Last oviposition	Death of female moth	Before oviposition	Of oviposition	From emergence to last oviposition	Of life of female after oviposition					
							Hrs.	*Min.*				*Days*	*Days*	*Days*	*Days*	*Days*		*No.*	*No.*	*No.*
33	May 13	May 19	7.00 p. m.	8.30 p. m.	8.45 p. m.	8.50 p. m.		15	May 20	June 1	June 1	7	13	19	0	19	5	101	20.2	37
34	May 14	May 20	8.00 p. m.	8.15 p. m.	8.30 p. m.	8.45 p. m.		15	May 21	May 23	May 24	7	3	9	1	10	3	62	20.6	36
35	---do----	May 19	9.15 p. m.	9.30 p. m.	9.45 p. m.	10.00 p. m.		15	---do----	May 21	May 23	7	1	7	2	9	1	21	21.0	21
36	May 15	May 18	7.00 a. m.	8.00 a. m.	9.45 a. m.	10.00 a. m.	1	45	May 19	May 28	May 31	4	10	13	3	16	8	149	18.6	28
37	---do----	May 20	8.00 p. m.	8.15 p. m.	8.30 p. m.	8.45 p. m.		15			May 28					13				0
38	May 16	May 19	8.00 p. m.	8.15 p. m.	8.30 p. m.	8.45 p. m.		15	May 23	May 27	June 29	7	5	11	2	13	2	8	4.0	7
39	May 17	---do----	8.15 p. m.	8.30 p. m.	8.45 p. m.	8.50 p. m.		15	May 20	May 28	June 1	3	9	11	4	15	5	53	10.6	31
40	May 19	May 20	8.00 p. m.	8.15 p. m.	9.15 p. m.	9.30 p. m.	1		May 21	June 5	June 6	2	16	17	1	18	12	206	17.1	38
41	---do----	---do----	8.15 p. m.	8.30 p. m.	9.15 p. m.	9.30 p. m.		45			May 25					6				0
42	May 20	May 21	8.15 p. m.	8.30 p. m.	9.15 p. m.	9.30 p. m.		45	May 27	May 29	June 1	7	3	9	3	12	2	23	11.5	15
43	---do----	---do----	8.15 p. m.	8.30 p. m.	10.00 p. m.	[1] 6.00 a. m.	1	30	May 23	May 30	June 2	3	8	10	3	13	3	41	13.6	26

[1] On day following date of previous observation.

Total number of eggs deposited, 3,325; average number of eggs deposited per female moth, 77.33; maximum number of eggs deposited by one female moth, 219; minimum number of eggs deposited by one female moth, 0.

HOURLY EMERGENCE OF MOTHS OF THE SPRING BROOD, 1921

The time of the emergence of 445 moths is shown in Table 89. The great majority of the moths emerged between 9 a. m. and 1 p. m.

TABLE 89.—*Emergence of 445 moths of the spring brood of the codling moth, hourly from 6 a. m. to 6 p. m., Cornelia, Ga., 1921*

Date of emergence of moths	Observation No.	Cage No.	Number of moths emerging at—													Total number of moths
			A. M.							P. M.						
			6	7	8	9	10	11	12	1	2	3	4	5	6	
May 6	1	1	0	0	0	0	0	46	53	35	7	5	3	4	1	154
May 7	2	1	0	0	0	0	20	67	25	4	11	0	1	1	0	129
May 9	3	1	0	0	0	0	43	17	9	16	5	2	3	3	0	98
May 10	4	1	1	2	0	0	6	22	17	6	4	2	0	4	0	64
Total			1	2	0	0	69	152	104	61	27	9	7	12	1	445

TIME SPENT IN EMERGING BY MOTHS OF THE SPRING BROOD, 1921

Fifty-four individuals were observed from the time each moth first broke the pupal case until it was ready to take flight. The average time that 42 moths spent in emerging was 22 minutes 14 seconds. (Table 90.)

TABLE 90.—*Data of observations on the emergence of 54 individual codling moths of the spring brood, Cornelia, Ga., 1921*

Moth No.	First appearance of pupal case breaking at (a. m.)—	Pupal case fully broken at (a. m.)—	Moth emerged from pupal case at (a. m.)—	Moth's wings up for drying at (a. m.)—	Moth's wings down at (a. m.)—	Time moth spent breaking pupal case	Time moth spent leaving pupal case	Time moth spent resting	Time moth spent drying wings	Total time moth spent in emerging
						Minutes	*Minutes*	*Minutes*	*Minutes*	*Minutes*
1	9. 19½	9. 26¾	9. 28¼			7¼	1½			
2	9. 27½	9. 32¾		9. 44¼	9. 54¾	5¼			10½	27¼
3			9. 32¼	9. 41¾				9½		
4	9. 31¾	9. 32¾	9. 36½		9. 56½	1	3¾			24¾
5	9. 31¾		9. 38	9. 47½	9. 58¾			9½	11¼	27
6		9. 58	10. 00¾	10. 09	10. 20½		2¾	8¼	11½	
7	9. 42½	9. 43¼	9. 48½	9. 56¾	10. 08¼	¾	5¼	8¼	11½	25¾
8	9. 45¼	9. 48½		10. 00¼		3¼				
9	10. 45	10. 46½	11. 00½			1½	14			
10	10. 52½	10. 56¼	10. 59	11. 05½	11. 14	3¾	2¾	6½	8½	21½
11		10. 03½	10. 05¼				1¾			
12			10. 07¾	10. 17				9¼		
13		10. 13½	10. 15½	10. 26½			2	11		
14		10. 16	10. 18				2			
15	10. 45	10. 46½	10. 47	10. 52¾	10. 07½	1½	½	5¾	14¾	22½
16	11. 21½	11. 22½	11. 24½	11. 33	11. 43	1	2	8½	10	21½
17	10. 53	10. 53¾	10. 54	11. 04¼	11. 13	¾	¼	10¼	8¾	20
18	10. 51	10. 51½	11. 00	11. 07	11. 18	½	8½	7	11	27
19	10. 51	10. 52	10. 52¾	11. 09¾	11. 19¼	1	¾	17	9½	28¼
20	9. 55	9. 55¼	10. 03	11. 08¼	10. 17¼	¼	7¾	5¼	9	22¼
21	11. 04¾	11. 05	11. 06½	11. 15¾	11. 21	¼	1½	9¼	5¼	16¼
22	11. 07¾	11. 08¾	11. 10¼	11. 20	11. 31	1	1½	9¾	11	23¼
23	11. 11	11. 15¾	11. 21¾	11. 28	11. 37½	4¾	6	6¼	9½	26½
24	11. 13	11. 14	11. 14½	11. 21½	11. 29	1	½	7	7½	16
25	11. 21¾	11. 22	11. 25	11. 35	11. 44	¼	3	10	9	22¼
26	11. 18	11. 18½	11. 19	11. 30	11. 37½	½	½	11	7½	19½
27	11. 20½	11. 21	11. 23	11. 37¾	11. 39½	½	2	14¾	1¾	18
28	11. 27½	11. 28½	11. 29	11. 39¾	11. 49	1	½	10¾	9¼	21½

TABLE 90.—*Data of observations on the emergence of 54 individual codling moths of the spring brood, Cornelia, Ga., 1921*—Continued

Moth No.	First appearance of pupal case breaking at (a. m.)—	Pupal case fully broken at (a. m.)—	Moth emerged from pupal case at (a. m.)—	Moth's wings up for drying at (a. m.)—	Moth's wings down at (a. m.)—	Time moth spent breaking pupal case	Time moth spent leaving pupal case	Time moth spent resting	Time moth spent drying wings	Total time moth spent in emerging
						Minutes	*Minutes*	*Minutes*	*Minutes*	*Minutes*
29	10. 35	10. 36	10. 39½	10. 48¼	10. 58	1	3½	8¾	9¾	23
30			10. 50	11. 00	11. 10			10	10	
31	10. 56	10. 56½	10. 57½	11. 06	11. 15½	½	1	8½	9½	19½
32	9. 07½	9. 08	9. 09¾	9. 21	9. 31	½	1¾	11¼	10	23½
33	9. 12	9. 14½	9. 15½	9. 27	9. 37½	2½	1	11½	10½	25½
34			9. 23	9. 37½	9. 46½			14½	9	
35	10. 57½	10. 58	10. 58½	11. 07	11. 15½	½	½	8½	8½	18
36	10. 58	10. 58½	11. 00	11. 10	11. 19	½	1½	10	9	21
37	10. 59	10. 59½	11. 01½	11. 10½	11. 19½	½	2	9	9	20½
38	10. 24½	10. 25	10. 27	10. 36	10. 47	½	2	9	11	22½
39	10. 27	10. 27¾	10. 29	10. 38½	10. 49	¾	1¼	9½	10½	22
40			10. 29	10. 38	10. 49			9	11	
41	9 22½	9. 23½	9. 26	9. 36½	9. 47	1	2½	10½	10½	24½
42	9. 32½	9. 43½	9. 44¼	9. 56¼	9. 59	11	¾	12	2¾	26½
43	10. 34¾	10. 35½	10. 37½	10. 46	10. 57	¾	2	8½	11	22¼
44	10. 33½	10. 34¼	10. 35	10. 37	10. 54	¾	¾	2	17	20½
45	10. 34¾	10. 35½	10. 37½	10. 46	10. 57	¾	2	8½	11	22¼
46	11. 04½	11. 06¼	11. 08	11. 16	11. 25	1¾	1¾	8	9	20½
47	11. 00	11. 09	11. 10¼	11. 20	11. 28	9	1¼	9¾	8	28
48	10. 13	10. 14	10. 15	10. 24	10. 31½	1	1	9	7½	18½
49	9. 35½	9. 36	9. 37	9. 48	9. 53½	½	1	11	5½	18
50	9. 52	9. 54½	9. 55½	10. 05½	10. 16	2½	1	10	10½	24
51	9. 52	9. 53	9. 54	10. 04½	10. 14	1	1	10½	9½	22
52	10. 00	10. 00½	10. 01¼	10. 02¼	10. 13	½	¾	1	10¾	13
53	10. 01	10. 01½	10. 09	10. 13	10. 24	½	7½	4	11	23
54	10. 19½	10. 20	10. 23¼	10. 33	10. 43	½	3¼	9¾	10	23½
Average						1′ 43″	2′ 26″	9′ 07″	9′ 32″	22′ 14″
Maximum						11′ 00″	14′ 00″	17′ 00″	17′ 00″	28′ 15″
Minimum						0′ 15″	0′ 15″	1′ 00″	1′ 45″	13′ 00″

HOURLY EMERGENCE OF THE FIRST-BROOD CODLING MOTHS, 1921

Observations on emergence of moths were made hourly from 6 a. m. to 9 p. m. (Table 91.) The majority of the 279 moths emerged between 10 a. m. and 3 p. m. None emerged between 5 a. m. and 9 a. m. (Seven moths had emerged between 9 p. m. and 5 a. m.)

TABLE 91.—*Emergence of 279 codling moths of the first brood, hourly, from 9 a. m. to 9 p. m., Cornelia, Ga., 1921*

Date of emergence of moths	Observation No.	Cage No.	Number of moths emerging at—													Total number of moths
			A. M.				P. M.									
			9	10	11	12	1	2	3	4	5	6	7	8	9	
July 1	1	1	0	1	2	4	1	9	5	5	0	2	0	0	4	33
Do	3	2	0	0	3	4	1	4	3	2	4	2	0	0	0	23
Do	3	3	2	8	14	8	2	7	4	4	0	4	3	0	0	56
Do	4	4	0	2	1	5	1	4	1	1	3	2	0	0	0	20
July 2	5	1	10	3	6	13	16	9	6	7	4	2	0	0	0	76
Do	6	2	1	1	1	1	5	4	2	1	2	1	0	0	0	19
Do	7	3	2	3	2	3	4	4	3	2	2	1	9	0	0	26
Do	8	4	1	1	1	3	8	2	7	3	0	0	0	0	0	26
Total			16	19	30	41	38	43	31	25	15	14	3	0	4	279

OVIPOSITION BY INDIVIDUAL CODLING MOTHS OF THE SPRING BROOD, 1921

The summarized results (Table 92) of the observations on oviposition show that 50 moths deposited a total of 3,045 eggs, or an average of 60.9 each. The maximum number of eggs laid was 205.

TABLE 92.—*Oviposition by 50 individual codling moths of the spring brood, Cornelia, Ga., 1921*

Pair No.	Date of—				Length of period				Total length of life of female moth	Days on which oviposition occurred	Eggs deposited	Average eggs per oviposition	Maximum eggs deposited in one day
	Emergence of moths	First oviposition	Last oviposition	Death of female moth	Before oviposition	Of oviposition	From emergence to last oviposition	Of life of female after oviposition					
					Days	*Days*	*Days*	*Days*	*Days*	*No.*	*No.*	*No.*	*No.*
1	Apr. 4	Apr. 8	Apr. 10	Apr. 18	4	3	6	8	14	2	55	27.5	46
2	Apr. 24	Apr. 26	May 8	May 9	2	13	14	1	15	4	37	9.3	16
3	do	Apr. 27	May 1	May 5	3	5	7	4	11	3	8	2.7	6
4	Apr. 25	Apr. 28	May 16	May 21	3	19	21	5	26	7	54	7.7	22
5	do	do	May 15	May 16	3	18	20	1	21	6	67	11.2	22
6	Apr. 26	May 15	May 20	May 24	19	6	24	4	28	3	6	2.0	3
7	do	Apr. 28	May 1	May 4	2	4	5	3	8	2	26	13.0	16
8	do	do	May 12	May 13	2	15	16	1	17	5	71	14.2	33
9	Apr. 28	May 1	May 14	May 18	3	14	16	4	20	5	43	8.6	35
10	do	do	May 12	May 17	3	12	14	5	19	6	47	7.8	14
11	do	do	May 8	May 8	3	8	10	0	10	5	47	9.4	32
12	do	do	May 1	May 6	3	1	3	5	8	1	17	17.0	17
13	May 2	May 5	May 15	May 21	3	11	13	6	19	2	2	1.0	1
14	do	do	May 24	May 30	3	20	22	6	28	10	84	8.4	22
15	May 6	May 8	May 15	May 16	2	8	9	1	10	4	30	7.5	15
16	May 7	May 10	May 22	May 30	3	13	15	8	23	9	133	14.8	55
17	May 8	May 12	May 17	May 17	4	6	9	0	9	4	37	9.3	24
18	May 9	do	May 15	May 19	3	4	6	4	10	4	65	16.3	62
19	do	do	May 24	May 25	3	13	15	1	16	9	45	5.0	11
20	do	do	do	May 30	3	13	15	6	21	10	95	9.5	28
21	May 10	do	May 12	May 17	2	1	2	5	7	1	7	7.0	7
22	do	do	May 20	May 31	2	9	10	11	21	6	68	11.3	19
23	do	do	May 25	May 30	2	14	15	5	20	8	120	15.0	37
24	do	May 16	May 22	May 31	6	7	12	9	21	6	110	18.3	52
25	May 11	May 15	May 24	May 25	4	10	13	1	14	8	105	13.1	30
26	May 12	May 14	do	May 27	2	11	12	3	15	10	119	11.9	42
27	May 13	May 15	May 20	May 21	2	6	7	1	8	3	16	5.3	10
28	do	do	May 28	May 31	2	14	15	3	18	9	77	8.6	30
29	do	do	May 17	May 20	2	3	4	3	7	2	5	2.5	4
30	do	do	May 24	May 30	2	10	11	6	17	8	65	8.1	28
31	do	do	May 17	May 21	2	3	4	4	8	3	15	5.0	10
32	do	do	May 22	May 22	2	8	9	0	9	7	25	3.6	5
33	do	do	May 15	May 16	2	1	2	1	3	1	22	22.0	22
34	do	do	May 20	May 21	2	6	7	1	8	4	61	15.3	50
35	May 15	May 17	May 22	May 24	2	6	7	2	9	4	19	4.8	8
36	do	do	May 19	May 21	2	3	4	2	6	3	73	24.3	43
37	do	do	do	May 25	2	3	4	6	10	3	59	19.7	51
38	May 16	May 20	May 25	May 30	4	6	9	5	14	6	101	16.8	30
39	May 17	May 19	May 28	do	2	10	11	2	13	10	175	17.5	49
40	do	May 21	May 24	May 26	4	4	7	2	9	4	98	24.5	58
41	May 18	May 20	May 26	May 30	2	7	8	4	12	6	37	6.2	10
42	May 19	May 22	May 24	June 1	3	3	5	8	13	3	43	14.3	32
43	May 20	do	do	May 25	2	3	4	1	5	3	14	4.7	14
44	May 21	May 23	May 28	June 2	2	6	7	5	12	4	9	2.3	2
45	May 22	May 24	May 31	June 4	2	8	9	4	13	5	23	4.6	6
46	May 26	May 28	June 8	June 12	2	12	13	4	17	11	205	18.6	40
47	May 27	May 29	do	June 11	2	11	12	3	15	10	143	14.3	48
48	May 28	May 30	June 12	June 14	2	14	15	2	17	13	126	9.7	22
49	May 29	do	June 10	June 11	1	12	12	1	13	5	24	4.8	8
50	May 13	May 15	June 24	May 26	2	10	11	2	13	8	112	14.0	33
Total										275	3,045		

OVIPOSITION BY INDIVIDUAL CODLING MOTHS OF THE FIRST BROOD, 1921

It will be noted in Table 93, which gives in detail the oviposition data of 35 moths, that the average number of eggs laid per female moth was 103.31. The maximum number of eggs deposited by one female moth was 227, the minimum was 2.

TABLE 93.—*Oviposition by 35 individual codling moths of the first brood, Cornelia, Ga., 1921*

Pair No.	Date of—				Length of period				Total length of life of female moth	Days on which oviposition occurred	Total eggs deposited	Average eggs per oviposition	Maximum eggs deposited in one day
	Emergence of moths	First oviposition	Last oviposition	Death of female moth	Before oviposition	Of oviposition	From emergence to last oviposition	Of life of female after oviposition					
					Days	*Days*	*Days*	*Days*	*Days*	*No.*	*No.*	*No.*	*No.*
1	June 24	July 1	July 5	July 10	7	5	11	5	16	2	3	1.50	2
2	do	June 28	July 4	July 6	4	7	10	2	12	7	179	25.57	69
3	June 26	June 29	do	July 4	3	6	8	0	8	5	99	19.80	54
4	June 28	July 3	July 11	July 15	5	9	13	4	17	8	183	22.88	96
5	do	do	July 3	July 10	5	1	5	7	12	2	2	1.00	2
6	June 29	July 1	July 4	do	2	4	5	6	11	4	52	13.00	28
7	do	July 3	July 5	do	4	3	6	5	11	2	10	5.00	7
8	do	July 1	July 8	July 9	2	8	9	1	10	8	216	27.00	54
9	do	July 3	July 7	July 10	4	5	8	3	11	5	81	16.20	37
10	do	July 2	July 4	July 11	3	3	5	7	12	3	52	17.33	42
11	do	July 1	July 9	do	2	9	10	2	12	9	227	25.22	59
12	do	July 2	July 5	July 9	3	4	6	4	10	4	73	18.25	43
13	do	do	July 8	July 11	3	7	9	3	12	5	155	31.00	87
14	do	do	July 4	July 9	3	3	5	5	10	3	90	30.00	64
15 [1]	do	do	do	----------	3	3	5	-------	-------	3	29	9.67	11
16	do	July 1	do	July 6	2	4	5	2	7	4	139	34.75	46
17	June 30	do	July 5	July 9	1	5	5	4	9	5	126	25.20	52
18	do	July 2	July 6	July 8	2	5	6	2	8	5	132	26.40	47
19	do	July 11	July 11	July 13	11	1	11	2	13	1	9	9.00	9
20	June 2	July 4	July 10	July 15	2	7	8	5	13	3	75	25.00	38
21	do	do	July 9	do	2	6	7	6	13	6	196	32.67	92
22	do	July 5	July 11	July 11	3	7	9	0	9	5	116	23.20	60
23	do	July 4	July 10	do	2	7	8	1	9	4	70	17.50	31
24	do	do	July 5	do	2	2	3	6	9	2	37	18.50	26
25	July 5	July 7	July 9	do	2	3	4	2	6	3	80	26.67	74
26	do	July 8	July 12	July 15	3	5	7	3	10	5	88	17.60	33
27	do	July 7	July 11	do	2	5	6	4	10	4	57	14.25	41
28	do	do	July 10	do	2	4	5	5	10	4	169	42.25	60
29 [2]	do	July 8	July 9	----------	3	2	4	-------	-------	2	109	54.50	74
30	do	do	July 11	July 16	3	4	6	5	11	3	25	8.33	22
31	do	do	do	July 15	3	4	6	4	10	4	130	32.50	50
32	do	July 7	do	do	2	5	6	4	10	5	134	26.80	71
33	do	do	July 10	July 11	2	4	5	1	6	4	177	44.25	64
34	June 9	July 11	July 18	July 20	2	8	9	2	11	2	87	43.50	75
35	June 15	July 19	July 27	July 28	4	9	12	1	13	3	209	69.67	42

[1] Escaped July 5.

[2] Escaped July 10.

EXPERIMENT WITH UPPER AND LOWER BANDS

This experiment with bands was made to determine the percentage of larvae that leave the apple while it is on the tree and the percentage that leave after the apple has fallen. Four bearing apple trees of a late fall variety were selected and prepared by placing two burlap bands on the trunk of each tree, separated by a 6-inch strip of adhesive paste. The bands were examined every three days during the season; the number of larvae collected during each examination is shown in Table 94. The early collections produced a greater number of larvae from the upper bands and the last collections gave a greater number from the lower bands. The ratio of larvae collected from the bands was the same as the ratio of the number of apples on the ground to the number of apples on the tree. The proportion of larvae collected from the upper bands was 67.15 per cent; from the lower bands, 32.85 per cent.

TABLE 94.—*Number of codling-moth larvae collected from upper and lower bands placed on the trunks of four trees, Cornelia, Ga., 1921*

Collection No.	Date of collection	Number of larvae collected from upper band of tree				Total number collected from upper bands	Number of larvae collected from lower band of tree				Total number collected from lower bands	Total number of larvae collected
		Tree No.					Tree No.					
		1	2	3	4		1	2	3	4		
1	June 10	10	20	15	17	62	1	0	2	3	6	68
2	June 13	16	16	24	34	90	2	2	8	7	19	109
3	June 16	40	42	48	41	171	18	12	18	3	51	222
4	June 19	25	37	37	31	130	12	14	13	6	45	175
5	June 22	42	44	31	22	139	8	25	16	1	50	189
6	June 25	50	53	26	42	171	18	13	12	5	48	219
7	June 28	35	39	28	23	125	13	19	6	13	51	176
8	July 1	34	44	44	43	165	24	17	4	10	55	220
9	July 4	13	24	32	25	94	7	12	16	5	40	134
10	July 7	20	27	32	16	95	6	12	14	3	35	130
11	July 10	16	18	52	13	99	2	4	16	5	27	126
12	July 13	17	25	30	21	93	4	11	22	3	40	133
13	July 16	21	22	34	21	98	17	16	20	6	59	157
14	July 19	16	14	22	10	62	10	10	15	6	41	103
15	July 22	11	22	16	12	61	7	10	20	7	44	105
16	July 25	4	9	17	9	39	3	4	10	7	24	63
17	July 28	7	8	10	7	32	3	4	2	9	18	50
18	July 31	10	13	13	8	44	5	7	1	7	20	64
19	Aug. 3	4	16	8	9	37	2	9	4	3	18	55
20	Aug. 6	3	9	18	6	36	1	5	5	7	18	54
21	Aug. 9	7	4	7	11	29	3	4	1	6	14	43
22	Aug. 12	11	6	7	3	27	5	8	8	3	24	51
23	Aug. 15	1	2	6	2	11	2	9	7	4	22	33
24	Aug. 18	3	3	8	1	15	2	4	12	6	24	39
25	Aug. 21	5	4	0	0	9	3	10	9	0	22	31
26	Aug. 24	3	0	4	4	11	1	3	5	2	11	22
27	Aug. 27	4	4	1	0	9	3	2	3	6	14	23
28	Aug. 30	4	1	1	2	8	4	6	7	4	21	29
29	Sept. 2	1	1	1	1	4	3	15	2	3	23	27
30	Sept. 5	1	1	1	0	3	11	9	3	2	25	28
31	Sept. 8	2	0	0	0	2	13	6	0	0	19	21
32	Sept. 11	0	2	1	0	3	3	2	2	2	9	12
33	Sept. 14	0	0	0	0	0	2	2	3	1	8	8
34	Sept. 17	1	0	0	0	1	0	1	0	0	1	2
35	Sept. 20	0	0	2	0	2	0	3	1	1	5	7
36	Sept. 23	0	1	1	0	2	6	1	1	0	8	10
37	Sept. 26	1	0	0	0	1	2	1	0	0	3	4
38	Sept. 29	0	1	0	0	1	4	0	3	0	7	8
Total						1,981					969	2,950

HIBERNATING HABITS OF CODLING-MOTH LARVAE

Observations were made on the hibernating habits of nine individual codling-moth larvae. The larvae selected for these observations were taken from beneath the burlap bands of apple trees within six hours after the insects had left the fruit. The larvae were placed on various parts of an unsprayed apple tree growing under average conditions and observed continually from the time they were placed until they hibernated. On account of the tedious nature of the work, only nine observations were made. As shown by Table 95, in some cases the larvae wandered about for hours before locating a suitable place and some selected places other than the bark of the tree to construct their cocoons.

TABLE 95.—*Data of observations on hibernating habits of nine codling-moth larvae*

Larva No.	Time spent by larva in locating hibernating quarters	Hibernating quarters
	Hours	
1	4	Between apple and branch on the tree.
2	1	In sharp fork of the tree.
3	2	In soil at base of the tree.
4	½	Do.
5	¼	Do.
6	3½	Under leaf on the ground.
7	1	In soil at base of the tree.
8	3½	Beneath dead leaf on the ground.
9	½	In soil at base of the tree.

EFFICIENCY OF BANDS IN TRAPPING LARVAE

A 14-year-old Esopus Spitzenberg apple tree was thoroughly scraped of all rough bark scales and the crotches and holes in the tree were plugged with a cement filler, so that no hibernating places were left on the tree. Many larvae were collected each day and distributed on the upper branches and foliage of the tree. Only 20 per cent of the larvae were caught beneath a burlap band placed around the trunk of the tree. The other 80 per cent, no doubt, hibernated in the soil, beneath leaves and twigs on the ground, and in other suitable places on or about the tree.

SUMMARY

The foregoing account of the codling moth is based upon studies conducted in outdoor breeding shelter during 1920 and 1921, in northern Georgia.

The average growing season for this section is 198 days. During the season of 1920 a full brood of the codling moth and three partial broods were produced; whereas during the following season one full brood and four partial broods were produced.

A generalized review of the seasonal-history studies for 1920 and 1921 is given in Figure 21. The curves represent the normal activity of the different stages.

Table 96 presents a generalized summary in tabular form. Some of the dates in this table do not agree with the dates given in the detailed tables, owing to the fact that in some cases consideration was given to observations which are not recorded in the tables in the body of this bulletin.

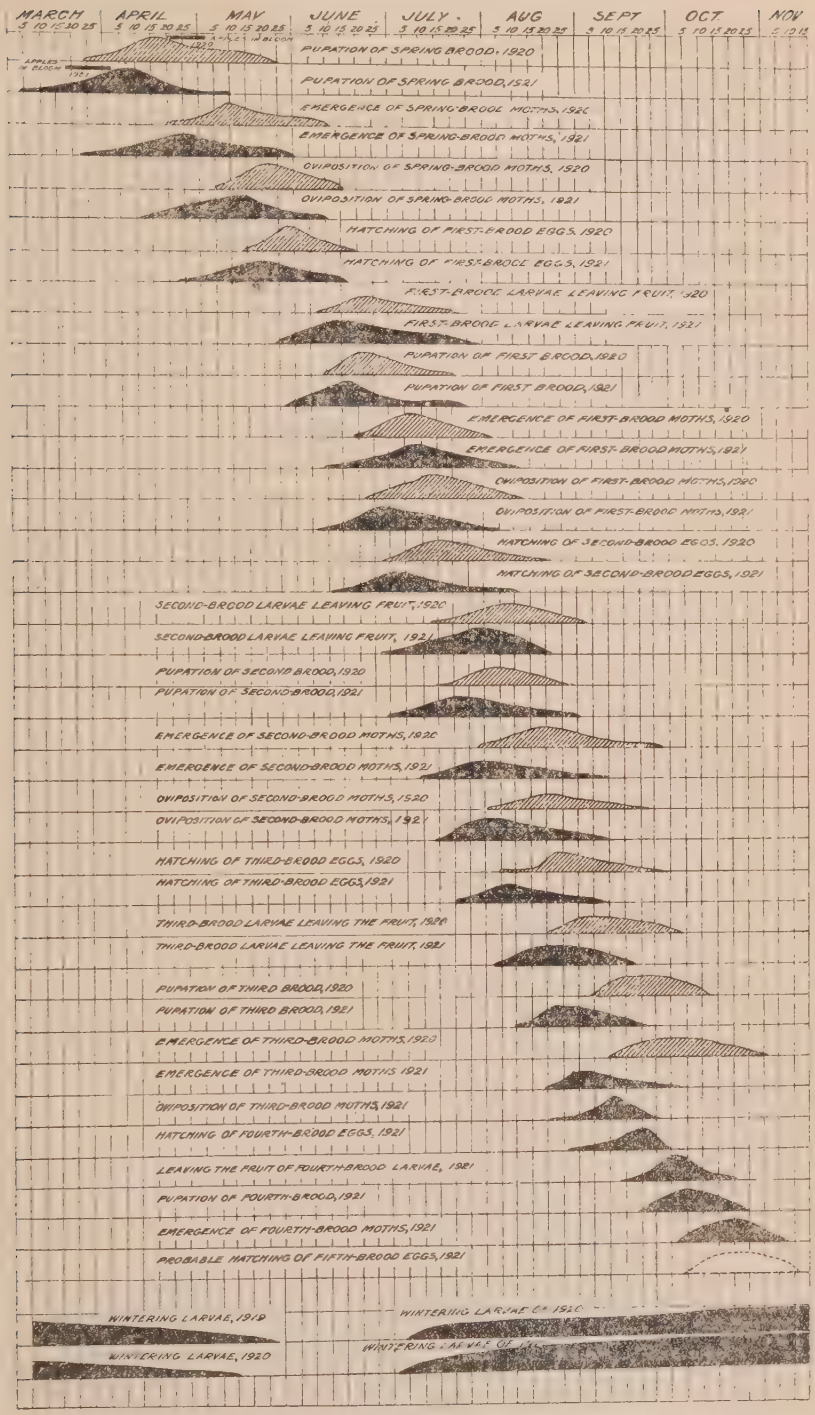

FIG. 21.—Diagram of the seasonal history of the codling moth during the seasons of 1920 and 1921 at Cornelia, Ga.

TABLE 96.—*Summary of the life-history studies of the codling moth for 1920 and 1921, Cornelia, Ga.*

	Brood									
	Spring		First		Second		Third		Fourth	
	1920	1921	1920	1921	1920	1921	1920	1921	1920	1921
Eggs observed, number			12,069	31,222	43,200	34,873	34,375	25,059	(2)	1,020
Incubation period of eggs in days:										
Average			8.22	9.88	6.04	5.39	6.65	5.93		5.60
Maximum			12	17	8	7	9	9		9
Minimum			5	5	5	5	6	5		5
Larvae observed during feeding period, number			1,984	2,510	3,936	1,850	968	850		217
Feeding period of larvae in days:										
Average			17.55	20.90	19.97	19.05	23.30	20.37		25.12
Maximum			31	39	35	36	44	38		43
Minimum			11	13	13	12	16	12		12
Larvae observed during cocooning period, number			1,569	1,525	954	707	13	42		8
Cocooning period of larvae in days:										
Average			5.08	7.70	7.59	6.07	7.31	6.12		13.00
Maximum			16	41	34	27	16	10		20
Minimum			1	2	2	1	3	3		4
Pupae observed, number	396	1,604	1,546	1,333	838	624	12	38		(1)
Pupal stage in days:										
Average	23	29.96	12.07	11.16	12.49	11.47	16.17	11.03		
Maximum	38	63	20	33	20	16	21	14		
Minimum	17	10	6	7	7	7	12	8		
Male moths observed, number	218	482	553	453	323	252	4	(1)		(1)
Life of male moth in days:										
Average	16.05	17.35	10.17	9.93	10.35	11.81	11.50			
Maximum	41	40	25	21	27	23	13			
Minimum	2	1	2	1	3	1	10			
Female moths observed, number	265	469	592	456	409	260	7	(1)		(2)
Life of female moth in days:										
Average	16.80	17.54	9.57	9.77	10.23	10.53	12.14			
Maximum	33	36	20	20	24	20	19			
Minimum	2	2	3	1	2	1	5			
Eggs deposited:										
First			May 6	Apr. 13	June 23	June 8	July 30	July 15		Aug. 21
Maximum number			May 19	May 12	July 12	June 27	Aug. 16	Aug. 1		Sept. 14
Last			June 14	June 10	Aug. 11	Aug. 4	Sept. 21	Sept. 7		Sept. 21
Eggs hatched:										
First			May 16	Apr. 24	June 29	June 13	Aug. 5	July 21		Aug. 30
Maximum number			May 27	May 23	July 18	July 2	Aug. 22	Aug. 7		Sept. 19
Last			June 17	June 16	Aug. 18	Aug. 8	Sept. 28	Sept. 7		Sept. 26

Larvae entered fruit:										
First	----------	----------	May 16	Apr. 24	June 29	June 13	Aug. 5	July 21	----------	Aug. 30
Maximum number	----------	----------	May 27	May 17	July 18	July 2	Aug. 22	Aug. 7	----------	Sept. 19
Last	----------	----------	June 17	June 16	Aug. 18	Aug. 8	Sept. 28	Sept. 7	----------	Sept. 26
Larvae left fruit:										
First	----------	----------	June 8	May 26	July 14	June 27	Aug. 20	Aug. 4	----------	Sept. 13
Maximum number	----------	----------	June 17	June 16	Aug. 8	July 28	Sept. 5	Aug. 20	----------	----------
Last	----------	----------	July 23	July 25	Sept. 4	Aug. 20	Oct. 2	Sept. 18	----------	Oct. 30
Pupation occurred:										
First	Mar. 24	Mar. 4[4]	June 10	May 29	July 17	June 30	Sept. 7	Aug. 10	----------	Sept. 20
Maximum number	Apr. 17	Apr. 7	June 17	June 12	Aug. 1	July 16	----------	Aug. 21	----------	----------
Last	May 23	May 6	July 18	July 25	Sept. 1	Aug. 30	Oct. 11	Sept. 22	----------	Oct. 22
Emergence of moth occurred:										
First	Apr. 20	Mar. 23	June 19	June 10	July 28	July 9	Sept. 10	Aug. 20	----------	Oct. 5
Maximum number	May 10	Apr. 25	July 5	June 26	Aug. 20	July 28	----------	Sept. 2	----------	----------
Last	June 9	May 30	July 31	Aug. 11	Sept. 26	Sept. 9	Nov. 1	Oct. 3	----------	----------

[1] Not recorded.
[2] Not recorded. Fourth-brood moth emerged but no eggs were laid.
[3] Eggs failed to hatch.
[4] Approximate date.

SPRING BROOD

In 1920 the length of the pupal stage of the spring brood averaged 23 days, the maximum was 38, and the minimum 17. In 1921 the average was 29.96 days, the maximum 63, and the minimum 10. In 1920 pupation commenced March 24, reached its maximum April 17, and ended May 23. In 1921 the earliest pupation took place about March 4 (see p. 44), was at its height April 7, and ended May 6.

The first moths of the spring brood in 1920 emerged April 20. The maximum emergence occurred May 10 and the last moth of this brood issued June 9. In 1921 the first spring-brood moth appeared March 23. The maximum emergence took place April 25 and the last moth issued May 30.

In 1920 the average length of life of the male moths was 16.05 days, the maximum 41, and the minimum 2. The average life of the female moths was 16.80 days, the maximum 33, and the minimum 2. In 1921 the average length of life of the male moths was 17.35 days, the maximum 40, and the minimum 1. The average life of the female moths was 17.54 days, the maximum 36, and the minimum 2.

The average number of eggs per female moth for this brood was 36.92 in 1920 and 63.03 in 1921.

FIRST GENERATION

In 1920 the first-brood eggs were first deposited May 6, maximum deposition occurred May 19, and deposition ended June 14. The following year the first eggs were laid April 13, maximum deposition occurred May 12, and deposition ended June 10.

The average length of the incubation period in 1920 was 8.22 days, the maximum 12, and the minimum 5. In 1921 the average length of the incubation period was 9.88 days, the maximum 17, and the minimum 5.

Inasmuch as the codling-moth larvae entered the fruit the same day as hatched, the dates for hatching are the same as those for larvae entering the fruit.

The first of the first-brood larvae in 1920 entered the fruit May 16, the maximum number entered May 27, and the last June 17. In 1921 the first of the first-brood larvae entered the fruit April 24, the maximum number May 17, and the last June 16.

The first larvae observed leaving the fruit in 1920 left it on June 8, the maximum number left June 17, and the last July 23. In 1921 the first-brood larvae began leaving the fruit on May 26, the maximum number left June 16, and the last July 25.

During the season of 1920 the length of the feeding period averaged 17.55 days, the maximum was 31, and the minimum 11. In the following year the average length of the feeding period was 20.9 days, the maximum 39, and the minimum 13.

The data for the length of the cocooning period as herein recorded are somewhat misleading, inasmuch as it is considered to be the period from the time the larva leaves the fruit to the time it pupates. The average length of the cocooning period of the larvae in 1920 was 5.08 days, the maximum 16, and the minimum 1. In 1921 the average was 7.7 days, the maximum 41, and the minimum 2.

In 1920 the length of the pupal stage of the first brood averaged 12.07 days, the maximum 20, and the minimum 6. In 1921 the aver-

age was 11.16 days, the maximum 33, and the minimum 7. In 1920 the pupation commenced June 10, reached its maximum June 17, and ended July 18. In 1921 the earliest pupation took place May 29, was at its height June 12, and ended July 25.

The first moths of the first brood in 1920 emerged June 19, the maximum emergence occurred July 5, and the last moth of this brood issued July 31. In 1921 the first of the first-brood moths appeared June 10, the maximum emergence took place June 26, and the last moth issued August 11.

In 1920 the average length of life of the male moths was 10.17 days, the maximum 25, and the minimum 2. The average life of the female moths was 9.57 days, the maximum 20, and the minimum 3. In 1921 the average length of life of the male moths was 9.93 days, the maximum 21, and the minimum 1. The average life of the female moths was 9.77 days, the maximum 20, and the minimum 1.

The average number of eggs per female moth was 73.04 in 1920 and 75.16 in 1921.

SECOND GENERATION

In 1920 the second-brood eggs were first deposited on June 23, the maximum deposition occurred on July 12, and deposition ended August 11. The following year the first eggs were laid on June 8, the maximum deposition occurred on June 27, and deposition ended August 4.

The average length of the incubation period in 1920 was 6.04 days, the maximum 8, and the minimum 5. In 1921 the average length of the incubation period was 5.39 days, the maximum 7, and the minimum 5.

The dates for hatching are the same as those for larvae entering the fruit.

The first of the second-brood larvae in 1920 entered the fruit on June 29, the maximum number entered July 18, and the last August 18. In 1921 the first of the second brood entered the fruit June 13, the maximum number July 2, and the last August 8.

The first larvae of this brood observed leaving the fruit in 1920 left it July 14, the maximum number left August 8, and the last September 4. In 1921 the second-brood larvae began leaving the fruit on June 27, the maximum number left July 28, and the last August 20.

During the season of 1920 the length of the feeding period averaged 19.97 days, the maximum was 35, and the minimum 13. During the following year the average length of the feeding period was 19.05 days, the maximum 36, and the minimum 12.

The average length of the cocooning period of the larvae in 1920 was 7.59 days, the maximum 34, and the minimum 2. In 1921 the average was 6.07 days, the maximum 27, and the minimum 1.

In 1920 pupation commenced July 17, reached its maximum August 1, and ended September 1. In 1921 the earliest pupation took place June 30, was at its height July 16, and ended August 30.

In 1920 the length of the pupal stage of the second brood averaged 12.49 days, the maximum was 20, and the minimum 7. In 1921 the average was 11.47 days, the maximum 16, and the minimum 7.

The first moths of this brood in 1920 emerged July 28, the maximum emergence occurred August 20, and the last moth of this brood

issued September 26. In 1921 the first-brood moths appeared July 9, the maximum emergence took place July 28, and the last moth issued September 9.

In 1920 the average length of life of the male moths was 10.35 days, the maximum 27, and the minimum 3. The average life of the female moths was 10.23 days, the maximum 24, and the minimum 2. In 1921 the figures gave the average length of life of the male moth as 11.81 days, the maximum 23, and the minimum 1. The average life of the female moths was 10.53 days, the maximum 20, and the minimum 1.

The average number of eggs per female moth was 85.59 in 1920 and 93.63 in 1921.

THIRD GENERATION

In 1920 the third-brood eggs were first deposited on July 30, the maximum deposition occurred on August 16, and deposition ended September 21. The following year the first eggs were laid on July 15, the maximum deposition occurred on August 1, and deposition ended September 7.

The average length of the incubation period in 1920 was 6.65 days, the maximum 9, and the minimum 6. In 1921 the average length of the incubation period was 5.93 days, the maximum 9, and the minimum 5.

The dates for hatching are identical with those for larvae entering the fruit.

The first of the third-brood larvae in 1920 entered the fruit August 5, the maximum number entered August 22, and the last September 28. In 1921 the first of the third brood entered the fruit July 21, the maximum number August 7, and the last September 7.

The first larva of this brood observed leaving the fruit in 1920 left it on August 20, the maximum number left September 5, and the last October 2. In 1921 the third-brood larvae began leaving the fruit August 4, the maximum number left August 20, and the last September 18.

During the season of 1920 the length of the feeding period averaged 23.3 days, the maximum was 44, and the minimum 16. In the following year the average length of the feeding period was 20.37 days, the maximum 38, and the minimum 12.

The average length of the cocooning period of the larvae in 1920 was 7.31 days, the maximum 16, and the minimum 3. In 1921 the average was 6.12 days, the maximum 10, and the minimum 3.

In 1920 pupation commenced September 7 and ended October 11. In 1921 the pupation began August 10, was at its height August 21, and ended September 22.

The first moths of this brood in 1920 emerged September 10 and the last of this brood issued November 1. In 1921 the first moths appeared August 20, the maximum number issued September 2, and the last moth issued October 3.

In 1920 the average length of life of the male moths was 11.5 days, the maximum 13, and the minimum 10. The average life of the female moths was 12.14 days, the maximum 19, and the minimum 5.

The average number of eggs per female moth was 63.75 in 1921.

FOURTH GENERATION

In 1921 the fourth-brood eggs were first deposited on August 21, the maximum deposition occurred on September 14, and deposition ended September 21.

In 1921 the average length of the incubation period was 5.6 days, the maximum 9, and the minimum 5.

In 1921 the first larva of this brood entered the fruit August 30, the maximum number entered September 19, and the last September 26.

In 1921 the first of the fourth-brood larvae left the fruit September 13 and the last October 30.

In 1921 the average length of the feeding period was 25.12 days, the maximum 43, and the minimum 12.

In 1921 the average length of the cocooning period was 13 days, the maximum 20, and the minimum 4.

In 1921 the pupation for this brood began September 20 and ended October 22.

MISCELLANEOUS

Two parasites were observed; *Exorista achracea* (Van der Wulp) and *Ascogaster carpocapsae* Vier.

The parasitic insects play a very important part in checking the codling moth in northern Georgia.

The majority of the moths emerge between 10 a. m. and 3. p. m.

Where the rough bark scales were removed from the tree and the burlap band substituted, only 20 per cent of the larvae spun up beneath the band.

The average time the moths spent in emerging was 22 minutes and 14 seconds.

The average number of eggs per female codling moth of the spring brood is lower than for the subsequent broods.

The fecundity of the codling moth, in Georgia, is high. This fact and the large number of broods in a season are the reasons for the insect being so abundant.

SPRAYING SCHEDULE

The same conditions that influence the growth of the apple tree affect the development of the codling moth. On account of seasonal variations it is essential that carefully conducted band-records be made each year to determine the emergence of moths of separate broods. Calendar days can not be counted on, but certain periods after the dropping of the petals of the apple blossoms can be used to determine the proper spray dates. No one schedule will meet the demands of all growers, but where the infestation is a medium one, the following schedule, based on results of the observations herein recorded, should be used:

Apply calyx spray after 90 per cent of the petals have fallen. This is the most important spray of all for the codling moth.

Apply first cover spray when the first-brood larvae commence to hatch, which is about two weeks after the petals have fallen.

Apply second cover spray about four weeks after the petals have fallen and prior to the hatching of the larvae of the first brood in maximum numbers. The larvae that are not killed by the above spray are the ones that produce the later broods.

Apply third cover spray from eight to nine weeks after the petals have dropped. At this time, under normal conditions, the first of the second brood commence to hatch.

Apply fourth cover spray 10 weeks after the petals have dropped, or when the maximum number of eggs of the second brood are hatching.

Apply fifth cover spray from 12 to 14 weeks after petals have dropped, to protect the fruit from the third-brood larvae. In cases where the control of the earliest broods has not been maintained, it may be necessary to apply a later spray against the late hatching larvae.

Orchardists, however, are particularly cautioned not to make spray applications of arsenicals, especially of lead arsenate, so late in the season that there will be objectionable amounts of spray residue on the harvested fruit. Any such fruit should be thoroughly treated to insure the removal of the residue before it is packed or sold. It should be noted that the world tolerance of 0.01 grain per pound is in effect in Great Britian and Germany and that fruit intended for export to these countries as well as to other European points will need to be within the world tolerance. It is expected that the world tolerance will become effective for all fruit, whether intended for export or for home consumption, in 1929, and, therefore, it will be necessary that all fruit be washed or otherwise cleansed to meet this requirement.

ORGANIZATION OF THE UNITED STATES DEPARTMENT OF AGRICULTURE

May 14, 1929

Secretary of Agriculture	ARTHUR M. HYDE.
Assistant Secretary	R. W. DUNLAP.
Director of Scientific Work	A. F. WOODS.
Director of Regulatory Work	WALTER G. CAMPBELL
Director of Extension Work	C. W. WARBURTON.
Director of Personnel and Business Administration.	W. W. STOCKBERGER.
Director of Information	M. S. EISENHOWER.
Solicitor	R. W. WILLIAMS.
Weather Bureau	CHARLES F. MARVIN, *Chief.*
Bureau of Animal Industry	JOHN R. MOHLER, *Chief.*
Bureau of Dairy Industry	O. E. REED, *Chief.*
Bureau of Plant Industry	WILLIAM A. TAYLOR, *Chief.*
Forest Service	R. Y. STUART, *Chief.*
Bureau of Chemistry and Soils	H. G. KNIGHT, *Chief.*
Bureau of Entomology	C. L. MARLATT, *Chief.*
Bureau of Biological Survey	PAUL G. REDINGTON, *Chief.*
Bureau of Public Roads	THOMAS H. MACDONALD, *Chief.*
Bureau of Agricultural Economics	NILS A. OLSEN, *Chief.*
Bureau of Home Economics	LOUISE STANLEY *Chief.*
Plant Quarantine and Control Administration	C. L. MARLATT, *Chief.*
Grain Futures Administration	J. W. T. DUVEL, *Chief.*
Food, Drug, and Insecticide Administration	WALTER G. CAMPBELL, *Director of Regulatory Work, in Charge.*
Office of Experiment Stations	E. W. ALLEN, *Chief.*
Office of Cooperative Extension Work	C. B. SMITH, *Chief.*
Library	CLARIBEL R. BARNETT, *Librarian.*

This bulletin is a contribution from

Bureau of Entomology	C. L. MARLATT, *Chief.*
Division of Deciduous Fruit Insects	A. L. QUAINTANCE, *in Charge.*

ADDITIONAL COPIES
OF THIS PUBLICATION MAY BE PROCURED FROM
THE SUPERINTENDENT OF DOCUMENTS
U. S. GOVERNMENT PRINTING OFFICE
WASHINGTON, D. C.
AT
20 CENTS PER COPY

▽